RYCOM INSTRUMENTS INC.
9351 East 59th Street
Raytown, Missouri, 64133

INSTRUCTION MANUAL

3136A

SELECTIVE VOLTMETER

Serial No. _____

Manual Part No. 030 00016 00

VIKING LABORATORIES INC.

7-76

CERTIFICATION

The RYCOM Instruments Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specification when it was shipped from the factory.

WARRANTY AND ASSISTANCE

All RYCOM Instruments Products are warranted against defects in material and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed below for the specified period we will repair or replace products that prove to be defective during the warranty period. No other warranty is expressed or implied. We are not liable for consequential damages.

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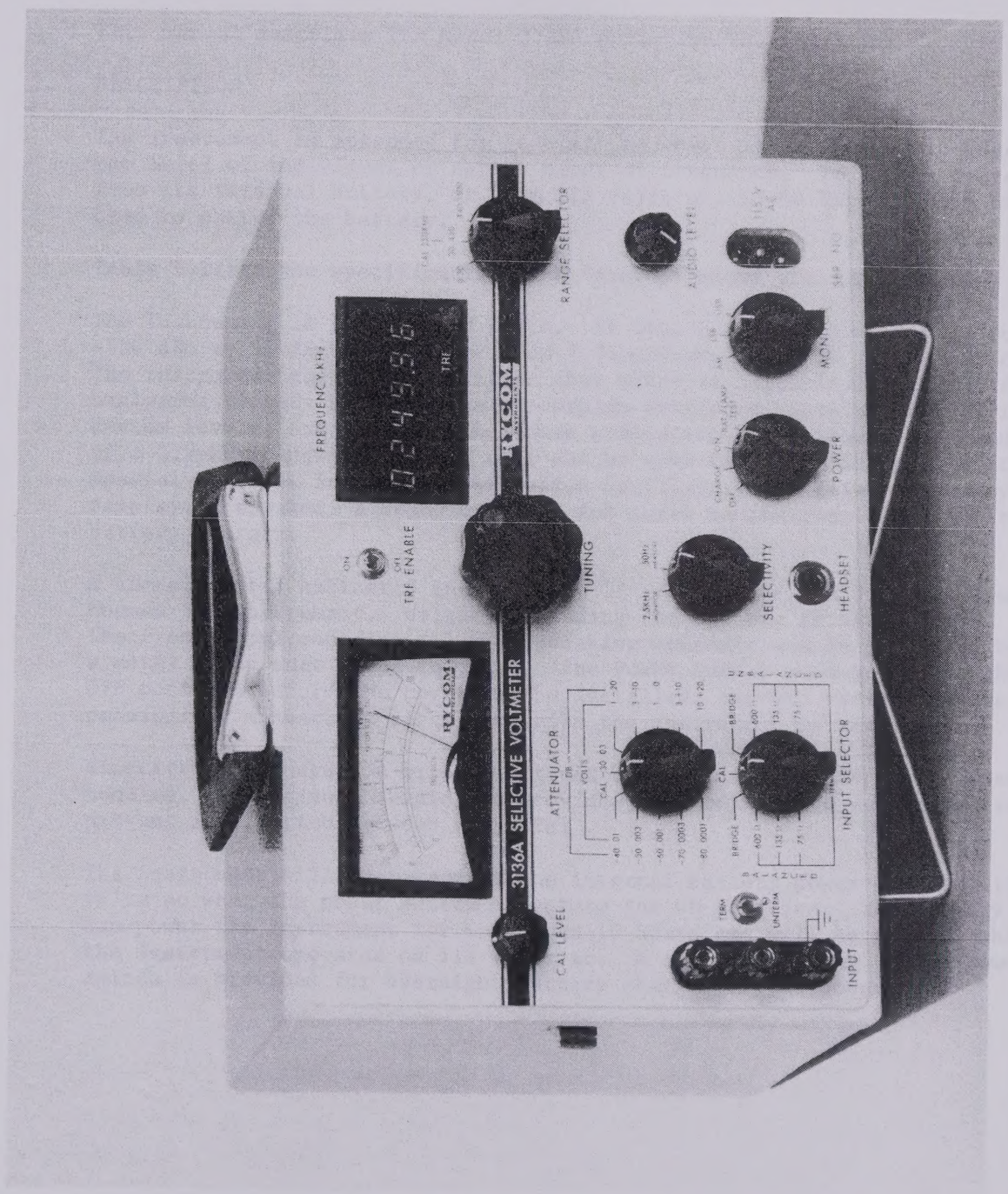

Figure 1. Model 3136A Selective Levelmeter

CHAPTER I
GENERAL

1. SCOPE

This manual describes the Model 3136A Selective Voltmeter.

2. DESCRIPTION

The instrument is intended for general use where it is desired to measure the level of individual or narrow bands of frequency. It can be operated from its internal battery, or from 115 volts ac, 50-60 Hz, which is also used to charge the battery.

Table 1 lists the specifications and figure 1 shows the instrument.

The instrument is fully solid state. It will measure signal level from -100 dBm to 22 dBm and voltage from 7.75 microvolts to 10 volts, 600-ohm. The instrument has a narrow filter that makes it particularly useful for analyzing closely spaced signals, complex waveforms, determining carrier system levels, and checking amplitude modulation percentages. Included is a 2.5-kHz bandwidth filter that can be used for searching and monitoring. Special features include a calibration oscillator, a digital frequency display, a speaker, a headphone jack for aural monitoring, and a built-in battery charger.

A compact metal cabinet 8 inches high, 12 inches wide and 9 inches deep houses the instrument. Weight, including the battery is 18.5 pounds. The front panel contains all the operating controls and is protected by a metal cover that snaps in place. The POWER switch must be set to the OFF position before the cover can be installed, thereby preventing the possibility of battery discharge while the instrument is not in use.

Circuitry is mounted on printed circuit boards and assembled into separate modules. Extensive shielding is provided for modules and components to prevent interaction between circuits.

The instrument will operate from the internal battery power or from 115 volts ac when the power switch is set to the ON position. The battery can power the instrument for more than 10 hours and will be charged while the instrument operates on 115 volts ac. A charge position on the power switch is provided for overnight battery charging by ac power.

Table 1. Specifications

CHARACTERISTIC	SPECIFICATION
FREQUENCY:	
Range	200 Hz to 1500 kHz with 50 Hz selectivity 400 Hz to 1500 kHz with 100 Hz selectivity 1000 Hz to 1500 kHz with 250 Hz selectivity 3 ranges
Accuracy	±20 Hz at 25° C
Temperature Stability	Less than 2 ppm/° C drift
Resolution	10 Hz
Display	LED's 6 digits in units of kHz
LEVEL MEASUREMENT:	
Range	-100 dBm to +22 dBm 600-ohm voltage range, 7.75 uV to 10 volts
Attenuator Range	-80 dB to +20 dB
Accuracy	±1 dB (1 kHz to 1500 kHz Bridging)
SELECTIVITY:	
Monitor	2500 Hz nominal between -3 dB points 10,000 Hz maximum between -60 dB points
Measure	50 Hz nominal between -3 dB points 230 Hz maximum between -60 dB points or 100 Hz nominal between -3 dB points 400 Hz maximum between -60 dB points or 250 Hz nominal between -3 dB points 1200 Hz maximum between -60 dB points
INPUT:	
Impedance	Selectable, 75, 135, 600 ohms, bridging (4000 ohms shunted by 15 pF at 250 kHz)
Configuration	Selectable, balanced or unbalanced Selectable, terminated or unterminated
SPURIOUS RESPONSE AND INTERMODULATION PRODUCTS:	Less than -55 dB from reference

Table 1. Specifications (cont)

CHARACTERISTIC	SPECIFICATION
INTERMEDIATE FREQUENCY:	2215 kHz
IMAGE REJECTION:	Greater than 70 dB at 100 kHz
I-F REJECTION:	Greater than 70 dB
INTERNAL CALIBRATION SOURCE:	
Frequency	250 kHz nominal
Level accuracy	Better than ±.3 dB over operating temperature range
TYPES OF DEMODULATION:	AM, USB, LSB
TEMPERATURE RANGE:	
Operating Storage	-10° C to +55° C -20° C to +85° C
POWER SUPPLY:	Internal rechargeable battery or 115 volts ac, 50-60 Hz for AC operation and for charging battery.
Battery capacity	10 hours between charges. A discharged battery will recharge overnight.
AC Watts	13 watts with fully charged battery 26 watts with unit operating and battery discharged
MECHANICAL:	
Dimensions	8 in. high x 12 in. wide x 9 in. deep (203.2 mm high x 304.8 mm wide x 228.6 mm deep)
Weight	18.5 pounds (8.3 kg)

CHAPTER II
OPERATION

1. PREPARATION.

The instrument has been thoroughly inspected at the factory and is covered by Warranty. However; before using the instrument, you should inspect it for shipping damage. Report any damage to the carrier and to RYCOM Instruments, Inc.

2. OPERATING CONTROLS AND INDICATORS.

Table 2 lists and describes the instrument controls and indicators.

Table 2. Operating Controls and Indicators

PANEL MARKING	DESCRIPTION	FUNCTION
RANGE SELECTOR	3-position rotary switch.	Selects frequency ranges in three steps.
TUNING	Drives tuning mechanism.	Tunes instrument to frequency indicated on frequency display.
TRF ENABLE	2-position toggle switch.	Controls automatic switching to a TRF frequency display.
SELECTIVITY	2-position rotary switch.	Selects bandwidth (measure) or (monitor).
ATTENUATOR	11-position rotary switch.	Controls sensitivity in 10 dB steps (-80 dB to +20 dB).
CAL LEVEL	Potentiometer.	Adjust overall gain during calibration.
MONITOR	3-position rotary switch.	Selects AM or single sideband (LSB, USB) demodulatation.
AUDIO LEVEL	Potentiometer.	Adjusts audio level for headset or speaker.
HEADSET	Headphone jack.	Provision for audio monitoring.
INPUT	Binding posts.	Signal input for measurements.

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Table 2. Operating Controls and Indicators (cont)

PANEL MARKING	DESCRIPTION	FUNCTION
POWER	4-position rotary switch spring loaded in BAT/LAMP TEST position.	Controls ac line or battery power and provides for battery testing.
115 VAC	Polarized connector.	Provision for connection 115 volt ac line.
TERM-UNTERM	2-position toggle switch.	Adds or removes terminating impedances.
INPUT SELECTOR	9-position rotary switch.	1. Selects input terminations of BRIDGE, 600-, 135-, or 75-ohm input with TERM-UNTERM switch in TERM position; BALANCED or UNBALANCED. 2. Selects CAL position for operational calibration.
FREQUENCY-KHz	6-digit display with two indicator lamps.	Provides a display of frequency in kHz with 10 cycle resolution. BFO lamp indicates the frequency displayed is the center frequency of the passband to which the meter is tuned. TRF lamp indicates the frequency displayed is the frequency of the input signal being measured.
No Marking	Meter	Indicates with ATTENUATOR the level of the detected input signal in dBm referenced to the impedance selected by the INPUT SELECTOR (Bridge reference 600-ohms). Indicates VRMS of the detected input signal on one of two voltage scales when INPUT SELECTOR is in a bridge or 600-ohm position. Correct voltage scale and multiplier are determined by the ATTENUATOR setting.

3. BATTERY.

The battery will provide up to 13 hours of operation between charges. A completely discharged battery will recharge in 16 hours or less. The instrument cannot be operated when the POWER switch is in the CHARGE position as THE charging circuit is switched in to a quick charge state while the remainder of the circuitry is switched out. When the POWER switch is in the ON position and the AC power applied, the battery is charged but at a rate slower than the quick charge rate.

If the instrument is operated on AC power more than 70% of the time, there should be no need for quick charging. If the instrument has operated battery powered for 10 hours, 20 hours of AC operation or a quick charge should take place before a second 10 hours of battery operation.

NOTE: Excessive use of the quick charge should be avoided as excessive over-charging will shorten battery life.

a. To quick charge battery, connect instrument to primary source (115 V ac) and set POWER switch to CHARGE.

b. To test condition of battery while it is delivering full load current, set POWER switch to BAT./LAMP TEST. The meter indication for an adequately charged battery will vary from unit to unit. This indication will be between .25 and .5 dB. The meter indication will start to fall when the battery voltage reaches a point where the calibration voltage is affected.

4. CALIBRATION.

a. Set the instrument switches and control as follows:

Switch/Control	Postition
POWER	ON
INPUT SELECTOR	CAL
ATTENUATOR	CAL -30 DB
SELECTIVITY	MEASURE
RANGE SELECTOR	30-440
TUNING	Peak meter reading near 250.00 kHz

Note: The calibration oscillator provides a signal for level calibration only. The oscillator frequency is nominaly 250 kHz, but can be expected to deviate.

b. Adjust CAL LEVEL for a 0 dBm reading. Unit is now calibrated to 0 dBm referenced to the selected input impedance.

5. INPUT SELECTOR SETTING AND METER CORRECTION.

a. INPUT SELECTOR on BRIDGE, or 600 Ohms, (TERM-UNTERM on UNTERM).

(1) Use this position to connect across a terminated 600-ohm line to make dBm measurements when calibrated.

(2) Use this position to connect across any line to make voltage measurements. Calibrate according to paragraph 4.

NOTE: Due to loading (4000 ohms at 250 kHz), apply the correction factors listed in table 3 for BRIDGE or (TERM-UNTERM on UNTERM) positions.

b. INPUT SELECTOR on 600 Ohms, (TERM-UNTERM on TERM). Use this position to terminate a 600-ohm line to make dBm (1 mW in 600 ohms) or voltage measurements. Calibrate according to paragraph 4.

c. INPUT SELECTOR On 135 Ohms, (TERM-UNTERM on TERM). Use this position to terminate a 135-ohm line to make dBm (1 mW in 135 ohms) measurements. Calibrate according to paragraph 4. Use UNTERM position for BRIDGE measurements.

d. INPUT SELECTOR on 75 Ohms, (TERM-UNTERM on TERM). Use this position to terminate a 75-ohm line to make dBm (1 mW in 75 ohms) measurements. Calibrate according to paragraph 4. Use UNTERM position for BRIDGE measurements.

Table 3. INPUT SELECTOR Setting and Meter Correction, BRIDGE or UNTERM Position.

INPUT SELECTOR	METER INDICATION	SOURCE OR LINE IMPEDANCE	METER CORRECTION FACTOR
BRIDGE or 600 ohms (UNTERM)	Volts and dBm (600 ohms)	600 Ohms	+1.2 dB
135 Ohms (UNTERM)	dBm (135 ohms)	135 ohms	+0.3 dB
75 Ohms (UNTERM)	dBm (75 ohms)	75 ohms	+0.2 dB

6. LINE MEASUREMENTS.

a. To make measurements below 500 Hz, perform the following:

(1) Remove the ac line cord from the 115 VAC receptacle to avoid possible spurious responses at 60 Hz harmonics. Set POWER switch to ON position.

(2) Connect the instrument INPUT jacks to the circuit to be tested.

(3) Calibrate the instrument according to paragraph 4.

(4) Set INPUT SELECTOR switch to desired impedance. See paragraph 5.

(5) Set RANGE SELECTOR switch and adjust TUNING control to frequency of signal to be measured.

(6) Set ATTENUATOR switch so meter indicates in upper 2/3 of scale.

(7) Adjust TUNING control for maximum indication on meter.

(8) Read meter indication in dBm. To obtain the input signal level, algebraically add meter indication to ATTENUATOR switch setting.

7. MONITORING.

Provision is made for monitoring audio signals that may be present on line signals under measurement. To monitor signals, set SELECTIVITY switch to MONITOR, set MONITOR switch to desired position (AM, LSB, or USB), and adjust AUDIO LEVEL control to the desired audio level.

8. FREQUENCY DISPLAY

TRF frequency readings are a measure of the frequency of the input signal in the instrument pass band. BFO frequency readings indicate the frequency to which the instrument is tuned. This instrument will automatically switch to the TRF mode when the input level reading exceeds -10 dB and the TRF ENABLE switch is in the ON position. If a pulsed or modulated input signal causes excessive mode changing or averaged frequency displays, TRF readings can be inhibited by putting the TRF ENABLE switch in the OFF position.

CHAPTER III
THEORY OF OPERATION

1. GENERAL.

The instrument employs a single conversion super-heterodyne circuit with a selectable bandpass to measure frequencies in the range of 0 to 1500 kHz. Figure 13 is a functional block diagram of the instrument and figure 14 is the basic schematic diagram.

At the input of the instrument, a switch is used to select the input signal from the calibration oscillator or from the front panel INPUT jacks. A low-pass filter and matching network are incorporated into the input circuit to attenuate unwanted high-frequency components and to provide proper impedances.

A variable attenuator provides up to 100 dB of attenuation in 10 dB steps to control sensitivity of the instrument. Tuning of the instrument is accomplished by a variable local oscillator whose output varies from 2215 to 3715 kHz. The input and local oscillator signals are heterodyned in a mixer to produce a 2215-kHz difference frequency. The I-F amplifier is tuned to 2215 kHz and it amplifies the mixer output.

The selectivity of the instrument is determined by crystal filters between the first and second I-F amplifiers. After amplification by the I-F amplifier, the signal is rectified and filtered in a meter detector circuit and then applied to a meter.

The second detector, when used with insertion frequency of 2213.5 kHz and 2216.5 kHz will produce single sideband demodulation for audio monitoring.

The calibration oscillator generates a signal and is amplitude regulated to provide an output level that is equivalent to -30 dBm at the INPUT jacks. Before measurements are made, the instrument sensitivity is calibrated by connecting the calibration oscillator output to the instrument input circuits and adjusting the I-F amplifier gain for a meter indication of 0 dBm.

When the instrument is used for power measurements, the variable attenuator is used to change sensitivity in calibrated steps of 10 dB. For example, assume that a signal level of -42 dBm is applied to the instrument input. Adjusting the attenuator to the -40 dB position will result in meter indication of -2 dBm. The input level is then determined by algebraically adding the meter indication to the attenuator setting:

$$-40 \text{ dB} + (-2 \text{ dBm}) = -42 \text{ dBm}$$

The local oscillator and I-F signals are mixed to generate a counter clocking signal to generate a TRF frequency display. For a BFO frequency display, the local oscillator and counter reference oscillator signals are mixed to generate the counter clocking signal.

2. INPUT ASSEMBLY A1.

The input circuits are composed of INPUT SELECTOR switch A1S1, TERM-UNTERM switch A1S3 and a 100-dB ATTENUATOR assembly A1AT1. Input signals are applied

to INPUT binding posts A1E1 and A1E2. The input bridging impedance is 4000 ohms at 250 kHz.

Resistor A1R1, A1R2, or A1R3 is switched into the circuit by A1S1 to terminate 75-, 135-, or 600-ohm lines. Resistors A1R20 and A1R22 form a -2.5 dB L-pad, and are switched into the circuit in INPUT SELECTOR position 135 ohm for measurements on 135-ohm impedance lines. Resistors A1R21 and A1R23 form a -9.0 dB L-pad, and are switched into the circuit in INPUT SELECTOR position 600 ohm for measurements on 600-ohm impedance lines. This allows one calibration to serve for 75-ohm, 135-ohm and 600-ohm dBm measurements.

3. VOLTAGE-FOLLOWER AND CALIBRATE OSCILLATOR ASSEMBLY A2.

The function of the voltage-follower is to match attenuator A1AT1 to lowpass filter FL3.

The calibrate oscillator is 250 kHz, crystal-controlled, and the output voltage swing is controlled by the regulated power supply voltage. The output is applied through CAL OSC ADJ potentiometer A2R12 to switch A1S1 for calibrating the instrument level.

4. LOWPASS FILTER FL3.

The lowpass filter has a cutoff frequency of 1760 kHz and provides 70 dB of attenuation at 2215 kHz. Input and output impedances are 150 ohms.

5. OSCILLATOR-MODULATOR ASSEMBLY A3.

The input signal is heterodyned with the local oscillator injection signal in balanced modulator diodes A3CR1. The diodes operate as a balanced shunt modulator, shorting the signal to ground during one-half the local oscillator cycle. The 2215-kHz output of the modulator is capacitively coupled to the base of first I-F amplifier A4Q1.

The modulator driver A3Q1 output is transformer-coupled through A3T1 to the modulator diodes. Local oscillator level at the junction of the modulator diodes is very small due to the matching of components. Input to the modulator driver is capacitively coupled from the emitter of local oscillator A3Q2.

The local oscillator is a modified Colpitts type with three switched frequency ranges. The frequency in each range is varied by adjusting TUNING capacitor C1, an 11-150 picofarad air-dielectric capacitor. The oscillator circuit is temperature-stabilized by A3C8.

6. I-F ASSEMBLY A4.

The 2215-kHz output of the modulator is capacitively coupled to the first I-F amplifier A4Q1. The amplifier and filter driver consists of three stages: A4Q1, A4Q2, and A4Q3. Gain is controlled by A4R5. Output of A4Q2 is transformer coupled to A4Q3, the filter driver.

The instrument has two crystal filters which are selected by the SELECTIVITY switch A4S4. The center frequency of both filters A4FL1 and A4FL2 is nominally 2215 kHz.

Trimmer capacitors A4C7 through A4C10 tune the filters for maximum flatness. Each filter has an input impedance of 4000 ohms and an output impedance of 1000 ohms.

The filter matching amplifier and second I-F amplifier consists of three stages: A4Q4, A4Q5, and A4Q6. Output of the crystal filter is capacitively coupled to filter matching amplifier A4Q4-A4Q5. CAL LEVEL control R2 is used to adjust bias current for A4Q5, thus controlling gain of the stage. The output of A4Q5 drives common-emitter amplifier A4Q6. The second I-F amplifier has a gain of 20 to 40 dB, depending upon the setting of CAL LEVEL control R2.

Third I-F amplifier A4Q7 provides 30 dB of gain and is transformer-coupled to I-F output amplifier A4Q8. The output of A4Q7 is also capacitively coupled to the meter detector circuit.

Meter detector diode A4CR1 is a half-wave detector with its output applied through A4R27 to power switch S7, which is connected to the meter.

I-F output amplifier A4Q8 acts as a buffer driving the reinsertion mixer and the frequency display.

7. DEMODULATOR ASSEMBLY A5.

The AM demodulator is a shunt type, A5CR3 is the diode. Monitor switch A5S5, when in the AM position, connects the cathode of A5CR3 to ground. R-F filtering is done by A5C10 and A5R16. The audio signal is capacitively coupled from AUDIO LEVEL control R1 to the input of audio amplifier A5IC1.

The sideband demodulator consists of A5CR2 and A5CR3, which are supplied with carrier signal from A5Q4. These diodes operate as a balanced shunt demodulator that shorts the I-F signal to ground during one-half the injection signal cycle. This produces an audio difference signal that is coupled to the audio amplifier A5IC1. The difference signal is approximately 1.5 kHz.

Carrier reinsertion oscillator A5Q3 is crystal-controlled by A5Y1 or A5Y2. Output is capacitively coupled to balanced phase splitter A5Q4, which supplies out-of-phase signals to demodulator diodes A5CR2 and A5CR3. MONITOR switch A5S5 is used to apply power to A5Q3 and A5Q4, and select the crystal for LSB or USB demodulation. LSB crystal A5Y1 is 1.5 kHz below and USB crystal A5Y2 is 1.5 kHz above the I-F center of 2215 kHz.

8. AUDIO AMPLIFIER ASSEMBLY A5

The audio amplifier is composed of A5IC1, an integrated circuit. The output of the demodulator is fed through R-F decoupling network A5R16 and A5C10 to AUDIO LEVEL control R1. Signal at the arm of R1 drives audio amplifier A5IC1. Voltage gain of the audio amplifier A5IC1 is approximately 48 dB which gives 90 mW output to the 100 ohm speaker LS1.

9. REGULATOR ASSEMBLY A5

The regulator is a series type, with A5Q1 as the series regulator transistor and A5Q2 the control amplifier. Reference diode A5VR1 (9.1 volts) controls bias for A5Q2. The output of the regulator is also connected through A5R4 to

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POWER switch S7 for checking battery condition. A meter indication between .25 and .5 dBm indicates that the battery charge is adequate for instrument operation.

10. DIGITAL FREQUENCY DISPLAY ASSEMBLY A11.

The digital frequency display assembly consists of three printed wiring boards, the Input Display board A8, the Display Timing board A9 and the Display Readout board A10. Figure 15 is the schematic diagram.

DISPLAY INPUT ASSEMBLY A8. A8Q1 operates as a crystal controlled oscillator, providing a reference signal for generating counter timing signals and also a beat oscillator signal for BFO frequency readings. Buffer amplifier A8Q2 isolates the oscillator from the load and converts low level oscillator signals to logic levels.

R-F amplifier A8I1 and A8Q3 convert an input from the local oscillator to a logic level signal to be used on A9. High speed comparator A8I2 converts an I-F input signal to a logic level signal for use on A9.

Operational amplifier A8I3a compares the dc voltage level which drives the instrument level meter, with the dc level from the A8R20 and A8R21 voltage divider. The divider is adjusted such that level readings above -10 dBm generate a low voltage output from A8I3a. This signal is coupled through A8E10, the TRF ENABLE switch S8 and A8E11 to A9 when the TRF mode is enabled. The OFF position of the TRF ENABLE switch S8 connects the high level at A8E9 to A8E11.

Emitter followers A8Q4 and A8Q5 provide current amplification needed to drive the TRF and BFO indicator lamps.

DISPLAY TIMING ASSEMBLY A9. The operation of the digital I-C's used on this board is described in Appendix A. Two functions are performed by the logic on this board. One is the generation of timing signals needed to control the frequency counting function on A10. The second is the mixing of the local oscillator and the I-F or BFO signals to generate a clock input to be counted by A10.

Flip-flops A9I1a, A9I1b and A9I2a provide square wave signals having frequencies which are one half the reference oscillator, the local oscillator and I-F frequencies respectively. I-C's A9I4, A9I7, A9I11, A9I6, A9I8 and flip-flop A9I12b and gates A9I3c and A9I3d generate timing signals. I-C's A9I4, A9I7 and A9I11 form a counter used to count reference oscillator cycles. Decoding logic provides for a low level signal at A9P1-6 for 44125 reference cycles (1/5 second). This low level commands A10 to count clock pulses during the 1/5 second interval. After the A9P1-6 signal rises to disable further counting, a short duration low going Latch Enable pulse at A9P1-7 commands A10 to transfer the count obtained to storage. The number in storage is the number being presented by the display readouts.

Delayed after the Latch Enable command, a high going pulse at A9P1-3 resets the A10 count to zero. Following the return of the reset pulse to the normal state, a high output from gate A9I3d delays counting by A9I4. This delay signal is removed with the next rise of a clock input to A10. This means that the start of each count interval is synchronized with the clock signal being counted. This synchronization reduces the amount of jitter that can exist in the least significant digit of a counter.

The state of flip-flop A9I2b determines whether the mixer is generating a TRF or BFO frequency output. The A9J1-5 input goes high to command a BFO mode. The BFO command can result from a low level meter signal or by the OFF position of the TRF ENABLE switch. When the BFO command is not present, the flip-flop is switched to a TRF state by the rise of the count disable signal at the end of a count cycle.

If a switch to the BFO command occurs during a count interval, flip-flop A9I5b generates a signal which prevents a storage command for that count cycle and prevents the displaying of an invalid count.

A9I5b outputs controls the signal present at the output of gate A9I3a. The A9I3a output is mixed with signals derived from the local oscillator to generate the A10 counter clocking signal. In the TRF mode, the A9I3a output is the I-F output divided by two and the mixer output will be one half the input frequency. Counting is done over a 1/5 second interval, providing a count output with 10 cycle resolution.

In the BFO mode, the A9I3a output is one half the reference oscillator frequency. The reference oscillator also doubles as a BFO oscillator. The reference oscillator is set 10 kHz below the I-F frequency to prevent signals generated in the display from being amplified by the I-F amplifiers.

The fact that the BFO frequency is 10 kHz lower than the I-F frequency, results in a clock input to A10 which is offset in frequency from the TRF input. This offset is subtracted from A10 counts. A10 counting is accomplished by cascading two, three-decade counters (A10I1 and A10I6). In the BFO mode, flip-flop A9I12a provides a count disabling signal to the second set of three decades. This disable signal is removed at the rise of the first clock input to the second counter I-C and prevents the first clock input (1000 counts) from being counted by the second three decades. This results in a displayed frequency corrected for the BFO oscillator offset.

For the two frequency ranges over 30 kHz, an open high-level input to A9E1 provides a low output from A9I9c which permits flip-flop A9I5a to be active while flip-flop A9I10a is stationary. The one half local oscillator signal clocks flip-flop A9I5a and samples the state of the A9I3a gate output. The A9I5a output will change state each time a 180° phase shift takes place between the sampled signal and the clocking edge of the one half local oscillator signal. This generates an output from the flip-flop with a frequency equal to the difference between the two input frequencies.

For low frequency differences, with a slow rate of phase shift, there is a possibility of jitter causing additional erroneous clock pulses from A9I5a. A second mixer circuit consisting of flip-flop A9I10a, A9I10b and exclusive or gate A9I9b is not susceptible to jitter. Bandwidth limitations limit the use of this mixer to the lower range. For this mixer, the output from A9I10b changes state each time flip-flop A9I10a is clocked and both the D input from A9J1-2 and SET input from A9I9b are low. Outputs from A9I10a toggle flip-flop A9I10b. With each toggle, the A9I10b input to A9I9b changes state and thereby shifts by 180° the phase of the A9I1b signal coupled to A9I10a. This means that before another output change can take place, a 180° phase shift between mixer inputs is required. Any phase shift less than nominally 90° in the reverse direction cannot generate an unwanted clock pulse. Gate A9I9a serves

to combine the outputs of either mixer into a single clock signal to the A10 board.

A low (ground) input to A9E1 from the range switch activates the A9I10 mixer and holds the A9I5a output high.

Darlington transistor A9Q1 inverts the lamp test signal applied to A9E2.

DISPLAY READOUT ASSEMBLY A10. Clock signals from A9 are counted by A10I1 and A10I6, two three-decade counters operating in cascade. In addition to counting stages, these two I-C's each contain Latches for storing the count presented to the BCD outputs, and the gates and an oscillator required to multiplex the three decades to a single BCD output. The oscillator in A10I6 is slaved to that in A10I1.

The BCD signals are decoded to seven segment signals by the two decoder drivers A10I2 and A10I7.

I-C's A10I3, A10I4, A10I5, A10I8, A10I9 and A10I10 are high intensity seven segment readouts. Readout cathodes are driven from the decoder drivers through diodes which protect the readouts from reverse bias. Anode voltages are supplied by transistors A10Q1, A10Q2, or A10Q3 as driven by digit commands from the multiplexing portion of A10I1. The value of A10C1 determines the multiplexing scan frequency for both counter I-C's.

The reset input to A10 resets the counters and synchronizes the multiplexed outputs. The reset input occures during the time counting has been disenabled by a disenable input and after a Latch Enable signal has transfered the 1/5 second count-interval count to storage.

When the lamp test input to the display at A9E2 goes low, a high blank signal companied by a low phase signal generates all 8 outputs from the decoders.

11. CHARGING CONTROL ASSEMBLY A12.

Refer to figure 16 for the schematic diagram.

The charging control board controls the voltage applied to the lead acid storage battery when the instrument is connected to an ac power source. Power from the dc power supply is applied between terminals A12E1 and A12E3. The positive voltage is applied to A12E1. A three terminal regulator A13I1 in the power supply holds the A12E1 voltage 5.0 volts above a reference voltage generated at A12E2. The constant 5.0 volt drop across A12R3 and A12R4 along with a constant current input to A12E2 from the power supply regulator provide for a constant current flow through A12TR1, A12CR1 and A12R5 in parallel, and in series with A12R6. This constant current and the resulting A12E2 and A12E1 voltages are set by adjusting A12R3.

The ac power at A12E1 is coupled through A12CR2 and A12E4 to the power switch and on to the battery and the rest of the instrument when the power switch S7 is in the ON position. If no ac is applied, A12CR2 prevents battery power from being lost through the control and power supply. A12R3 is adjusted for the application of a 13.5 volt float voltage to the battery and instrument at 25° C.

Transistor A12Q1, resistors A12R1, A12R2, A12R9, and A12CR3 act to limit the current supplied. This action prevents excessive current flow through a very low battery. A12E4 and A12E5 are shorted, meaning transitor A12Q2 is held off when the power switch is in the ON position.

Temperature sensitive components thermistor A12RT1 and stabistor A12CR1 provide for a change in voltage at A12E2 with temperature and insures an optimum float voltage over a wide temperature range.

With the power switch in the CHARGE position, transistor A12Q2 is permitted to turn on and the A12E4 voltage is applied only to the battery. The voltage at A12E4 will vary according to the state of charge on the battery. For a charged battery and low current flow through A12R2, A12Q1 will be off. The voltage at A12E4 will be about 13.6 volts. If the battery is charging at about 100 mA rate, A12Q1 will be partly turned on and will turn on A12Q2. With A12Q2 on and A12CR3 off, the current through A12Q2 increases the voltage drop through A12R6 and results in about 14.4 volts at A12E4. This provides for optimum charging of a low battery. Additional increases in charge current due to battery condition will eventually turn on diode A12CR3. Current flow through A12CR3 lowers the A12E4 voltage and keeps the charging current within a safe limit.

Transistor A12Q3 is an emitter-follower used to supply a regulated voltage to the display. This emitter-follower prevents excessive loading of the A5 regulator.

12. POWER SUPPLY ASSEMBLY A13.

The power supply module consists of power transformer A13T1, bridge rectifier A13CR1, filter capacitor A13C1, three terminal regulator A13I1 and filter capacitor A13C2. The dc voltage out of the regulator at terminal 2 is controlled by the bias voltage applied at terminal 3 supplied from A12E2 of the charging control board. A13I1 is a 5 volt regulator meaning the regulator output voltage will be 5 volts above the A12E2 voltage.

CHAPTER IV
MAINTENANCE

1. INTRODUCTION.

This instrument will give comparatively trouble-free performance provided normal operating procedures are observed. In the event of any malfunction, first check the battery by turning the POWER switch to the BAT./LAMP TEST position and observing the meter for an indication of greater than 0 dBm.

Before attempting to trouble shoot the instrument, you should study Chapter III, Theory of Operation.

2. TEST EQUIPMENT.

The test equipment of table 4 is required to test and align the instrument, but it is not supplied.

Table 4. Test Equipment

NAME	USE	REQUIRED CHARACTERISTICS
Sweep Generator and Display Unit	Align I-F amplifiers and crystal filters.	1. Center frequency between 50 and 500 kHz. 2. Sweep width variable from 5 to 40 kHz. 3. Sweep rate: 1/sec. to 4/sec.
Vtvm		Triplett 850 or equivalent.
Frequency Counter		1. Minimum counting rate 3000 kHz. 2. Gate time 1 sec. and 0.01 sec. 3. Variable display time.
Signal Generator		Hewlett-Packard 651 or equivalent.
Ac vtvm		Ballantine 303 or equivalent.
Oscilloscope	Trouble shoot display.	Textronics 465 or equivalent.

3. TROUBLE SHOOTING.

Before proceeding with step 1 in table 5, connect equipment in the test setup shown in figure 2 and perform the following steps:

a. Set the instrument switches and controls as follows:

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Switch/Control	Position
INPUT SELECTOR	BRIDGE
RANGE SELECTOR	30-440
TUNING	250 kHz
ATTENUATOR	0 dB
CAL LEVEL	Fully Clockwise
SELECTIVITY	MONITOR
TRF ENABLE	OFF

b. Adjust signal generator for 0.78 V, 250-kHz output signal.

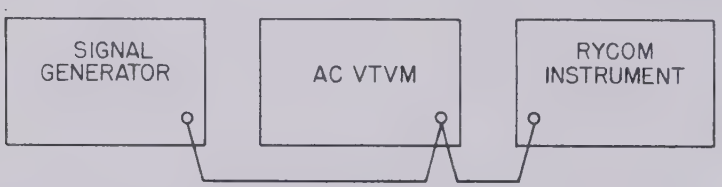

Figure 2
Test Setup for Assembly Isolation

Table 5. Assembly Isolation.

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Turn unit on. Rotate POWER switch to BAT./ LAMP TEST.	Meter reads above 0 dB.	Battery needs recharge or Power system. See table 6.
2	Rotate POWER switch to BAT./LAMP TEST.	Display indicates 8888.88 BFO indication.	Trouble is in Assembly A11. See table 7.
3	Set TRF ENABLE switch to ON and rotate POWER switch to BAT./LAMP TEST.	TRF indication.	Trouble is in Assembly A11. See table 7.
4	Tune to 250 kHz and obtain 0 dB meter reading.	0 dBm meter reading. Display indicates 250.00 kHz. TRF indicator lamp on.	0 dB not attained. Go to step 6. Display or indication incorrect. Trouble is in Assembly A11. See table 7.
5	Set ATTENUATOR to +10 dB.	-10 dBm meter indication. display and indicator lamp unchanged.	Trouble is in Assembly A11.

Table 5. Assembly Isolation. (cont)

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
6	Set TRF ENABLE switch to OFF. Set ATTENUATOR to 0 dB.	Display indicates Approx. 250.00 kHz. BFO indicator lamp on.	Trouble is in display Assembly A11. See table 7.
7	Set ATTENUATOR to -60 dB. Connect ac vtvm to pin 7 of Assembly A2.	Ac vtvm indicates 27 mV.	Trouble is in input Assembly A1. See table 8.
8	Set INPUT SELECTOR to CAL. Connect ac vtvm to pin 7 on Assembly A2.	Ac vtvm indicates .9 mV.	Trouble is in calibrate oscillator on Assembly A2. See table 10.
9	Set INPUT SELECTOR to BRIDGE. Connect ac vtvm to pin 1 on Assembly A2.	Ac vtvm indicates 12 mV.	Trouble is in voltage-follower on Assembly A2. See table 9.
10	Connect ac vtvm to pin E2 on Assembly A4.	Ac vtvm indicates 7 mV.	Trouble is in FL3 lowpass filter. See table 11.
11	Set RANGE SELECTOR to 0-30. Tune to minimum frequency.	Instrument meter indicates past full scale.	Trouble is in oscillator Assembly A3. See table 12.
12	Set RANGE SELECTOR to 30-440. Tune to 250 kHz and obtain 0 dBm meter reading. Set ATTENUATOR to +10 dB. Connect ac vtvm to E6 on Assembly A4.	Ac vtvm indicates 35 mV.	Trouble is in I-F Assembly A4. See table 13.
13	Connect ac vtvm to E10 on Assembly A5. Set MONITOR switch to LSB; AUDIO LEVEL to 2/3 cw.	Ac vtvm indicates 5.7 mV.	Trouble is in reinsertion oscillator Assembly A5. See table 14.
14	Connect ac vtvm to E12 on Assembly A5.	Ac vtvm indicates above .3 V.	Trouble is in audio amplifier Assembly A5. See table 15.

Table 6. Charging Control Assembly A12 Trouble Shooting

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Disconnect the unit battery and place a 510 ohm 1/2 W, load across A12E10 and A12E11. Turn unit on. Set POWER switch to CHARGE.	Voltages for A12E1 thru A12E5 should be within ±.1 V of the upper values given on schematic, figure 16.	A12E4 shorted to ground or problem is on power supply Assembly A13.
		A12E1 should be 5 V above A12E2.	If difference is equal to 5 V but level is slightly high or low; check A12Q2 collector. Adjust A12R3. If A12E1, A12E2, A12E4 all low: check A12Q1. If A12E1, A12E2, A12E4 all high: check A12Q2.
2	Disconnect the unit battery and place a 100 ohm 3 W, load across A12E10 and A12E11. Turn unit on. Set POWER switch to CHARGE.	Voltages for A12E1 thru A12E5 should be within ±.1 V of the lower values given on schematic, figure 16.	A12E4 and other voltages low: check A12Q2, A12Q1. Check S7.
3	Set POWER switch to ON.	A12E4 and A12E5 voltages should be equal. A12E1, A12E2, A12E4 voltages should be near those in step 1.	Check S7.
		A12Q3 voltages should be within ±.1 V of the values given on schematic, figure 16.	A12E6 voltage not correct: check A5Q1 and A5Q2. See table 16. Check for defective A12Q3.

Table 7. Frequency Display Trouble Shooting

The procedures of Table 7 will aid in locating a frequency display problem with a minimum amount of disassembly. The frequency display assembly should not be removed from the unit until the steps in the following table indicate that access to internal points are necessary. When it has been determined that the problem is internal to the display assembly, access can be obtained by the following steps:

1. Remove TUNING and RANGE SELECTOR switch knobs.

2. Remove the TRF ENABLE switch from the front panel.

3. Remove the Local Oscillator A3 cover.

4. Remove the three machine screws which are accessed through three holes in the rear gear plate.

5. Pull the Display and Local Oscillator modules back away from the front panel.

6. Remove the four machine screws from the front of the Display assembly and remove the cover to trouble shoot printed circuit boards A8, A9, and A10.

7. After removing the cover, use the four cover screws to hold boards in place and provide grounding while boards are being tested.

The three display boards tend to operate in cascade. By first monitoring signals on A10, then A9 and finally A8, it should not be necessary to remove a board from the display case until it is known that the problem is on or below that board. Each board can operate with the board mated in front of it removed to determine whether the generator or load produced the fault condition.

It is assumed that the person servicing the instrument has a knowledge of transistors and Integrated circuit operation. Appendix A contains descriptions for the digital I-C's used.

Signal levels and wave shapes occurring in the display are shown on the display schematic. Signal at A12J1-3, -6 and -7 consists of a narrow pulse at a very low duty cycle and may be difficult to monitor on an oscilloscope. When applied to a counter input, these signals will generate a 5 cycle per second count.

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Turn unit on. Rotate POWER switch to BAT./ LAMP TEST position.	Meter reads above 0 dB. Display indicates 8888.88.	If meter indicates below 0 dB: Battery needs recharged. Check POWER switch S7. Check power system A12, A13, A5Q1, A5Q2.

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Table 7. Frequency Display Trouble Shooting (cont)

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1 (cont)			If blank display and TRF, BFO indicators: Check A12Q3 and A11C1 (A8E1) voltage levels. Go to step 4. If no change in display: Check A11C4 (A9E2) voltage level. If all segments change state: Check A10I2 pins 6 and 7 to verify A9Q1 inversion. Unlit segment in all three right hand digits: Verify the associated A10I2 segment output is less than 6 V. Verify associated diode of A10CR1 thru A10CR7 is not open. Unlit segment in all three left hand digits: Verify the associated A10I7 segment output is less than 6 V. Verify associated diode of A10CR8 thru A10CR14 is not open. Two digits blank: Check associated transistor A10Q1, A10Q2, A10Q3 or A10I1 $\overline{DS}$ output. Two digits lit: Check A10I1 pin 3 and A10I1 $\overline{DS}$ outputs, see wave-shapes in detail B on schematic figure 15. Unlit segments not common to half of the display: Replace defective readout.

Table 7. Frequency Display Trouble Shooting (cont)

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
2	Set TRF ENABLE switch to ON. Rotate POWER switch to BAT./LAMP TEST position.	TRF indicator lamp on.	If no indication, check A9I2 pin 13, lamp DS2, A8Q5. If BFO indicator lamp is on: Check TRF ENABLE switch S8 for proper DC levels and switch operation. If S8 red wire always near 8 V: Verify grounding A11C2 (A8E4) input line is detected by instrument meter. Check A8R20 adjustment, check A8I3a. Verify step 4 operation, if step 4 performance in normal, check A8I2b.
3	Set TRF ENABLE switch to OFF. Rotate POWER switch to BAT./LAMP TEST position.	BFO indicator lamp on.	Check TRF ENABLE switch S8 for proper DC levels and switch operation. Check A9I2 pin 12, lamp DS1, A8Q4.
4	Set POWER switch to ON. Tune instrument over the 0-30 frequency range.	A stable display of frequencies from .2 kHz to above 30.0 kHz.	Check A8TP1. If A8TP1 signal incorrect, check A8Q1 and A8Q2. Temporarily disconnect and check P1 (A8E2) input signal. Reconnect P1. Check A10J1-1, -9. If no signal at A10J1-9, problem is on A9 or A8, or A10 is overloading A9I12a. Remove A10. If A10J1-9 signal is not corrected by the removal of A10, then proceed to checks for A9I1a and A9I1b. The A1J1-9 signal is required for other A10 controlling signals to be correct.

Table 7. Frequency Display Trouble Shooting (cont)

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
4 (cont)			Check A10J1-6,-7,-3 and -9 for waveshapes shown in detail A of schematic diagram, fig. 15. Check A10J1-2, -8, -4 and -5 levels or signals. If A10J1-6, -7, -3, and -9 signals are correct, check A10I1, A10I6, A10I2 and A10I7. If problem is not on A10, check A9I1a and A9I1b. If A9I1 pins 1 and 13 are correct but no signal on A9P1-9, check A9I3b, A9I3a, A9I10a, A9I10b, A9I9c, A9I9b and A9I9a. If A9I1 pins 1 and 13 and A9P1-9 are all correct but A9P1-6, -7 or -3 are not correct, check A9I4, A9I7, A9I11, A9I6, A9I8, A9I3c, A9I3d and A9I12b. If A9I1 pin 11 input is missing or low level, check A8I1, A8Q3.
5	Set TRF ENABLE to ON, INPUT SELECTOR to CAL, ATTENUATOR to CAL-30 DB, SELECTIVITY to MONITOR, TUNING for peak meter indication near 250 kHz, CAL LEVEL for meter indication greater than -2 dBm.	TRF frequency display at 250.0 ±.1 kHz.	TRF indication but frequency display is erratic or incorrect: Temporarily disconnect and check the signal at P2 (A8E3), Reconnect P2. If P2 correct check A9I2a.
6	With the instrument tuned to the Cal Osc., adjust TUNING or CAL LEVEL to obtain meter readings above and below -10 dBm.	Indicators shall switch from BFO to TRF as the meter reading increases past -10 dBm.	Adjust A8R20 to obtain a -10 dBm switching point. BFO display 10 kHz above TRF display: Check A10J1 -8. Check A9I9d, A9I12a.

Table 7. Frequency Display Trouble Shooting (cont)

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
7	Set RANGE SELECTOR to 440-1500 position. Adjust TUNING for a 1500.00 kHz BFO display.	Steady 1500.00 kHz display.	Check A11C3 (A9E1) input. Check A9I9c, A9I5a, A9I9a, A9I10a and A9I10b.

Table 8. Input Assembly A1 Trouble Shooting

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Set INPUT SELECTOR to 75-ohms (unbalanced). Connect Ac vtvm to coaxial lead from S1 to AT1 on Assembly A1. Set ATTENUATOR to -80 dB.	Ac vtvm indicates 0.78 V.	Check A1C1, A1S1 connections and A1T1 continuity.
2	Verify proper voltage scaling and loading effect for Input Selector and Termination switch positions.	Input Impd / UN-TERM / TERM 75Ω .78 V .47 V 135Ω .72 V .52 V 600Ω .36 V .33 V BRIDGE .36 V .33 V	Check A1S1 and A1S2 connections. Check for damaged resistors A1R1 thru A1R3, A1R20 thru A1R23.
3	Set INPUT SELECTOR to 75-ohms (unbalanced). Connect ac vtvm to pin 7 on Assembly A2.	Ac vtvm indicates 0.78 V.	Check A1S2 connections and A1R7.
4	Set ATTENUATOR to -70 dB.	Ac vtvm indicates .246 V.	Check A1S2 connections and A1R8, A1R9.
5	Advance signal level and ATTENUATOR setting in 10 dB steps.	Ac vtvm indicates .246 V. If the signal level limit has been reached, further advances of the ATTENUATOR should reduce the ac vtvm reading by 10 dB. (first to .078 V followed by .0246 V).	Check A1S2 connections and A1R10 thru A1R19.

Table 9. Voltage-Follower Assembly A2 Trouble Shooting

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Set signal generator terminated by 50 ohm load to 250 kHz at -30 dBm and connect to pin 7 of Assembly A2. Connect ac vtvm to pin 1. Set ATTENUATOR to -10 dB.	Ac vtvm indicates 11 mV.	Check A2Q1, A2Q3, and A2Q4 voltages. See table 16.

Table 10. Calibrate Oscillator Assembly A2 Trouble Shooting

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Set INPUT SELECTOR to CAL. Connect ac vtvm to pin 4 on Assembly A2.	Ac vtvm indicates 24.5 mV.	Check A2Q2 voltages. See table 16.

Table 11. Lowpass Filter FL3 Trouble Shooting

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Set signal generator to 250 kHz at 24.5 mV and connect to IN on FL3. Connect ac vtvm to OUT on FL3.	Ac vtvm indicates 25.0 mV.	Check continuity of FL3.
2	Connect ohmmeter from pin IN to OUT on FL3.	Ohmmeter indicates less than 1 ohm.	Trouble is in FL3.

Table 12. Local Oscillator Assembly A3 Trouble Shooting

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	connect ac vtvm to junction of A3R1 and A3CR1.	Ac vtvm indicates .75 V.	Check A3Q1 and A3Q2 voltages. See table 16.
2	Connect ac vtvm to junction of A3R5 and A3R6.	Ac vtvm indicates between 0.15 and 0.3 V.	Check A3Q2 voltages. See table 16.

Table 13. I-F Amplifier Assembly A4 Trouble Shooting

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Set signal generator to 2215 kHz at -90 dB (24.5 uV) and connect to E2 on Assembly A4. Rotate CAL LEVEL fully cw. Set SELECTIVITY to MONITOR.	Instrument indicates between -15 dB to -9 dB.	Adjust A4T1, A4T2, and A4T3 for maximum indication on meter. Check A4Q1 thru A4Q8 voltages. See table 16.

Table 14. Reinsertion Oscillator Assembly A5 Trouble Shooting

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Set MONITOR to LSB. Connect ac vtvm to base of A5Q4.	Ac vtvm indicates 1.0 V.	Check A5Q3 voltages. See table 16. Check crystals.
2	Connect ac vtvm to junction of A5C8	Ac vtvm indicates .6 V.	Check A5Q4 voltages. See table 16.

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Table 15. Audio Amplifier Assembly A5 Trouble Shooting

STEP	PROCEDURE	NORMAL INDICATION	IF INDICATION IS ABNORMAL
1	Set signal generator to 1 kHz at 11 mV and connect to E10 on Assembly A5. Rotate AUDIO LEVEL control R1 fully cw. Connect ac vtvm to E12 on Assembly A5.	Ac vtvm indicates greater than 2.5 V.	Check A5IC1 voltages. See table 17.

Table 16. Transistor Voltage Chart

Set instrument controls:

1. No signal input
2. CAL LEVEL fully cw
3. MONITOR to LSB
4. INPUT SELECTOR to CAL

Readings taken with vtvm and should be ±10%.
All voltages positive with respect to chassis ground.

MODULE	TRANSISTOR	EMITTER	BASE	COLLECTOR
A2	Q2	2.3	2.1	6.0
	Q3	9.0	7.8	1.70
	Q4	1.1	1.70	9.0
	Q1	Source = 1.1	Gate = 0	Drain = 8.4
A3	Q1	1.85	2.3	6.8
	Q2	1.6	2.0	8.0
A4	Q1	3.3	3.9	9.5
	Q2	2.6	3.3	9.5
	Q3	1.35	2.0	4.6
	Q4	1.9	2.5	9.0
	Q5	1.2	1.9	3.6
	Q6	2.2	2.8	8.9
	Q7	0.9	1.5	8.8
	Q8	1.5	2.2	5.0
A5	Q1	9.5	10.3	12.0
	Q2	0	0.65	10.3
	Q3	1.3	1.5	3.5
	Q4	1.7	2.0	7.8

Table 17. Linear Integrated Circuit Voltages

Test Conditions are same as those given in table 16.
N.C. = No connection.

INTEGRATED CIRCUIT	PINS 1	2	3	4	5	6	7	8
A5IC1	.15	12.0	7.0	7.0	13.0	8.4	13.5	Sig.
A8IC1	1.3	0	1.3	N.C.	6.2	8.0	7.9	N.C.
A8IC2	0	4.0	4.0	0	N.C.	N.C.	Sig.	8.0
A8IC3	0 or 7.0	0-.09	.018	0	0	0	0 or 7.0	8.0

4. ALIGNMENT.

a. Calibrate Oscillator. Due to normal aging, or replacement of parts, it may be necessary to calibrate the voltmeter. This is accomplished by comparing the calibrate oscillator output level with a known external source. Connect the equipment as shown in figure 3, then proceed with steps (1) through (8).

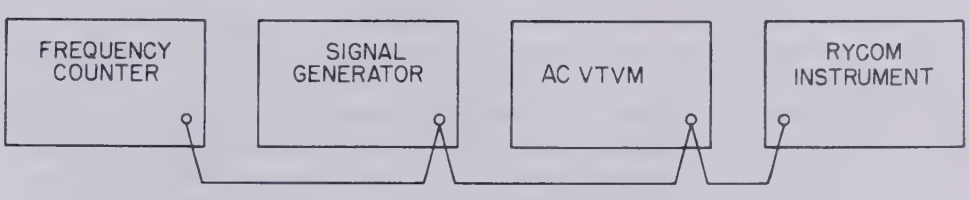

Figure 3
Test Setup for Level Calibration

(1) Set the instrument and controls as follows:

Switch/Control	Position
INPUT SELECTOR	BRIDGE
SELECTIVITY	MEASURE
ATTENUATOR	CAL -30 dB
RANGE SELECTOR	30-440
TUNING	250 kHz indication on readout display

(2) Adjust signal generator frequency to 250 kHz.

(3) Adjust signal generator output level to -30 dBm (24.5 mV).

(4) Adjust TUNING control for maximum indication on meter.

(5) Adjust CAL LEVEL for 0 dBm indication on meter.

(6) Set INPUT SELECTOR to CAL.

(7) Adjust TUNING control for maximum indication on meter.

(8) Adjust CAL OSC ADJ control A2R12 on Assembly A2 for 0 dBm indication on meter, (access hole for A2R12 is located behind the battery which will have to be moved aside). The instrument is now calibrated and ready for operation.

b. I-F Amplifier. The alignment of the 2215-kHz I-F amplifier, Assembly A4, is performed by using the internal 250-kHz calibrate oscillator as a signal source. Proceed as follows:

(1) Set the instrument and controls as follows:

Switch/Control	Position
INPUT SELECTOR	CAL
ATTENUATOR	CAL -30 dB
SELECTIVITY	MEASURE
RANGE SELECTOR	30-440
TUNING	Adjust for maximum meter indication

NOTE

Assembly A4 conver must be in place before aligning.

(2) Adjust CAL LEVEL (and A4R5 if needed) so meter indicates in upper one half of scale.

(3) Adjust A4T1, A4T2, and A4T3 with a non-metallic tuning tool for maximum meter indication.

(4) Set the ATTENUATOR to -20 dB. Adjust CAL LEVEL fully clockwise (maximum gain), and adjust A4R5 for a -4 dBm meter indication. This means maximum gain will be 6 dB above the nominal Cal Level.

(5) Check gain range by rotating CAL LEVEL to extreme counter-clockwise position (minimum gain). Meter should indicate approximately -8 dB with ATTENUATOR switch set to -30 dB.

NOTE: An alternate setting of A4R5 may be required to obtain both a stable TRF frequency display at a -10 dBm meter reading and intermodulation products more than -55 dB below the reference signals. Increasing I-F gain with A4R5 will tend to stabilize a TRF frequency display. Reducing I-F gain with A4R5 will reduce the level of intermodulation products.

c. Crystal Filters A4FL1 and A4FL2. Crystal filters A4FL1 and A4FL2 on assembly A4 can be adjusted for passband flatness by using the internal calibrate oscillator. Proceed as follows:

(1) Set the instrument and controls as follows:

Switch/Control	Position
INPUT SELECTOR	CAL
ATTENUATOR	CAL -30 dB
SELECTIVITY	MONITOR
RANGE SELECTOR	30-440
TUNING	250 kHz indication on readout display

(2) Adjust TUNING so meter indicates in valley of passband ripple.

(3) Adjust A4C9 and A4C10 for maximum meter indication.

(4) Repeat steps (2) and (3) until filter A4FL2 passband ripple is within ±0.5 dB.

(5) Set SELECTIVITY to MEASURE.

(6) Adjust TUNING for maximum meter indication.

(7) Adjust A4C7 and A4C8 for maximum meter indication.

(8) Repeat steps (6) and (7) until A4FL1 filter has a rounded peak response with no ripple.

(9) Set the instrument ATTENUATOR to -80 dB. Tune both above and below the measure filter center frequency. Note the highest level reading to which the instrument returns after passing through the first -60 dBm points (-90 dBm referenced to -30 dBm). If the level is above a -55 dB rejection level (-85 dBm referenced to -30 dBm), adjust A4C7 and A4C8 as required to obtain fallback levels below the -55 dB rejection level.

d. Local Oscillator and Frequency Display Adjustment.

(1) Connect the equipment as shown in figure 4.

(2) Adjust the equipment as follows:

Switch/Control	Position
Signal Generator	0 dBm level output at 1500.00 kHz
INPUT SELECTOR	BRIDGE (unbalanced)
ATTENUATOR	0 dB
SELECTIVITY	MONITOR
TRF ENABLE	ON
RANGE SELECTOR	440-1500

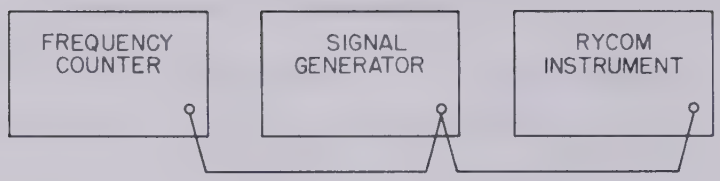

Figure 4
Test Setup for Frequency Alignment

(3) Tune the instrument for a TRF display of the 1500.00 kHz input.

(4) Adjust A8C1 to obtain 1500.00 kHz display.

(5) Tune the instrument for a maximum frequency display. Set the RANGE SELECTOR to each of the three frequency ranges and verify the maximum frequency is above the specified limit for the range.

(6) Tune the instrument for a minimum frequency display. Set the RANGE SELECTOR to each of the three frequency ranges and verify the minimum frequency is below the lower limit for the range. For the 0-30 kHz range, .10 kHz is a good lower limit. Before an instrument is fully warmed up, it may tune through zero frequency. This results from the fact that the tuned frequency of an instrument tends to drift as the instrument warms up. In order to guarantee a desired minimum frequency after a long period of use, it may be necessary for the instrument when cold to tune through the zero frequency point.

(7) If any of the above frequencies fail to meet the prescribed limits, capacitors A3C10, A3C12, A3C14 or A3C16 may be adjusted to achieve the following results:

(a) A3C10 - decreasing this value will increase the 440-1500 range frequencies.

(b) A3C12 - decreasing this value will increase the 30-440 range frequencies.

(c) A3C14 - decreasing this value will increase the 0-30 range frequencies.

(d) A3C16 - increasing this value will increase the bandwidth of the 0-30 range and will lower frequencies of this range.

(e) A3L3 - decreasing this value will increase the frequencies for all ranges.

CHAPTER V
PARTS LIST

1. HOW TO ORDER PARTS.

When ordering parts, always include:

a. Name, Model and Serial Number of the instrument.
b. Module and reference designation.
c. Part number.
d. Description.

Order parts from:

RYCOM INSTRUMENTS
9351 East 59th Street
Raytown, Missouri 64133 Telephone 816-353-2100

NOTE: $10.00 minimum on all orders.

2. LIST OF MANUFACTURERS.

Code is listed in parts list under MFR.

Code	Name and Address
01295	Texas Instruments, Inc. Semiconductor-Components Div. 13500 N. Central Expressway Dallas, Tex. 75231
03508	General Electric Co. Semi-Conductor Products Dept. Electronics Park Syracuse, N.Y. 13201
03877	Transitron Electronic Corp. 168-186 Albion St. Wakefield, Mass. 01880
04713	Motorola Semiconductor Products, Inc. 5005 E. McDowell Rd. Phoenix, Ariz. 85005
05397	Union Carbide Corp. Electronics Div. 270 Park Ave. New York, N.Y. 10017
06978	Aladdin Electronics Div. of Aladdin Ind. 705 Murfreesboro Road Nashville, Tenn. 37210
07263	Fairchild Semiconductor, Div. of Fairchild Camera and Instrument Corp. 464 Ellis St. Mountain View, Calif. 94040
11236	CTS of Berne, Inc. 406 Parr Rd. Berne, Ind. 46711
13571	Electronic Research Corp. 10005 W. 75th Overland Park, Kans. 66204
14752	Electro Cube 1710 S. Del Mar Ave. San Gabriel, Calif. 91776

Code	Name and Address
15801	Fenwal Electronics Div. of Kidde Walter and Co. Inc. 63 Fountain St. Farmingham, Ma. 01701
16299	Corning Glass Works Electronic Components Div. 3900 Electronics Drive Raleigh N.C. 27604
18410	RYCOM INSTRUMENTS RAILWAY COMMUNICATIONS, INC. 9351 E. 59th St. Raytown, Mo. 64133
22701	Bestran Corp. Dilectron Div. 2669 S. Myrtle Ave. Monrovia, Calif. 91016
25088	Siemens America Inc. 350 Fifth Ave. New York, N.Y. 10001
27014	National Semiconductor 2950 San Ysidro Way Santa Clara, Calif. 95051
29309	Richey Electronics, Inc. 1307 Dickerson Rd. Nashville, Tenn. 37213
29505	Temple Industries P.O. Box 468 Tecate, Calif. 92080
56289	Sprague Electric Co. North Adams, Mass. 01247
72136	Electro Motive Mfg. Co., Inc. South Park and John Streets Willimantic, Conn. 06226
72982	Erie Technological Products Inc. 644 W. 12th St. Erie, Pa. 16512
73899	JFD Electronics Corp. 15th at 62nd St. Brooklyn, N.Y. 11219
74970	E. F. Johnson Co. 299 10th Ave. S.W. Waseca, Minn. 56093
79089	Radio Corp of America Solid State and Receiving Tube Div. 415 S. 5th St. Harrison, N.J. 07029
80294	Bourns Inc. 1200 Columbia Ave. Riverside, Calif. 92507
81071	Schauer Mfg. Corp. 4500 Alpine Cincinnati, Ohio 45242
83701	Electronic Devices Inc. 21 Gray Oaks Ave. Yonkers, N.Y. 10710
84970	Sarkes Tarzian Inc. Broadcast Equipment Div. E Hillside Dr. Bloomington, Ind. 47401
91418	Radio Materials Co. 4242 W Bryn Mawr Chicago, Ill. 60646
91637	Dale Electronics Inc. P.O. Box 609 Columbus, Nebr. 68601
99848	Wilco Corp. 4030 W. 10th St. P.O. Box 22248 Indianapolis, Ind. 46222

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05397	Union Carbide Corp. Electronics Div. 270 Park Ave. New York, N.Y. 10017
06978	Aladdin Electronics Div. of Aladdin Ind. 705 Murfreesboro Road Nashville, Tenn. 37210
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11236	CTS of Berne, Inc. 406 Parr Rd. Berne, Ind. 46711
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84970	Sarkes Tarzian Inc. Broadcast Equipment Div. E Hillside Dr. Bloomington, Ind. 47401
91418	Radio Materials Co. 4242 W Bryn Mawr Chicago, Ill. 60646
91637	Dale Electronics Inc. P.O. Box 609 Columbus, Nebr. 68601
99848	Wilco Corp. 4030 W. 10th St. P.O. Box 22248 Indianapolis, Ind. 46222

PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	PARTS LOCATED ON FRONT PANEL OR CHASSIS			
BT1	Battery, 12 Volt, rechargeable	770 00002 01	18410	1
C1	Cap, var, air, 11-150 pF, type L	650 00002 02	18410	1
FL3	Filter, lowpass, 1.55 MHz cutoff frequency, 150 ohms input and output impedance	761 00005 00	18410	1
J1	Connector, electrical power	812 00027 00	18410	1
J2	Jack, headset	812 00009 00	18410	1
L1	Coil, rf, 15.6 uH	701 00008 00	18410	1
L2	Suppressor, parasitic	701 00005 00	18410	1
L3	Suppressor, parasitic	701 00013 00	18410	1
L4	Coil, rf, 1.5 mH	701 00014 00	18410	1
L5	Suppressor, parasitic	701 00016 00	18410	1
LS1	Loudspeaker, 3 inch	743 00003 00	18410	1
M1	Multimeter, replacement, 0-200 uA, 500 ohms dc resistance	740 00009 00	18410	1
P1	Plug, phono	812 00006 00	18410	2
P2	Plug, same as P1			
R1	Res, var, 25 k ohms ±30%, 1/3 W	540 00001 15	18410	1
R2	Res, var, 10 k ohms ±30%, 1/2 W	540 00001 10	18410	1
R3	Res, 47 ohms ±5%, 1/2 W, carbon	502 00470 00	18410	2
R4	Res, 47 ohms, same as R3			
S7	Switch, rotary, 3-pole, 4-pos, 1-deck	720 00033 00	18410	1
S8	Switch, toggle, spdt	722 00002 00	18410	1
WA1	Cord Assy, power	151 00011 00	18410	1

VIKING LABORATORIES INC.

PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	INPUT ASSEMBLY A1			
A1C1	Cap, 10 uF ±10%, 200 wvdc, mylar	230B1C106M	14752	1
A1C2	Cap, 0.1 uF (-20%, +80%), 25 wvdc, disc ceramic	5815000Y5U00 104Z	72982	1
A1E1	Binding Post, red	812 00038 00	18410	2
A1E2	Binding Post, same as A1E1			
A1E3	Binding Post, black	812 00038 01	18410	1
	Mounting Plate	825 00023 00	18410	1
A1R1	Res, 75 ohms ±5%, 2W, metal film	Type C-42S	16299	1
A1R2	Res, 140 ohms ±2%, 1 W, 125° C, film	Type C-32	16299	1
A1R3	Res, 681 ohms ±1%, 1/2 W, 70° C, film	511 56810 00	18410	1
A1R4	NOT USED			
A1R5	NOT USED			
A1R6	NOT USED			
A1R7	Res, 6040 ohms ±1%, 1/10 W, 125° C, film	511 36041 00	18410	1
A1R8	Res, 3400 ohms ±1%, 1/10 W, 125° C, film	511 33401 00	18410	1
A1R9	Res, 1580 ohms ±1%, 1/10 W, 125° C, film	511 31581 00	18410	1
A1R10	Res, 4530 ohms ±1%, 1/10 W, 125° C, film	511 34531 00	18410	1
A1R11	Res, 499 ohms ±1%, 1/10 W, 125° C, film	511 34990 00	18410	1
A1R12	Res, 4990 ohms ±1%, 1/10 W, 125° C, film	511 34991 00	18410	3
A1R13	Res, 4870 ohms ±1%, 1/10 W, 125° C, film	511 34871 00	18410	1
A1R14	Res, 158 ohms ±1%, 1/10 W, 125° C, film	511 31580 00	18410	1
A1R15	Res, 4990 ohms, same as A1R12			
A1R16	Res, 49.9 ohms ±1%, 1/10 W, 125° C, film	511 34998 00	18410	1
A1R17	Res, 4990 ohms, same as A1R12			
A1R18	Res, 15.8 ohms ±1%, 1/10 W, 125° C, film	511 31588 00	18410	2
A1R19	Res, 15.8 ohms, same as A1R18			
A1R20	Res, 1300 ohms ±1%, 1/10 W, 125° C, film	511 31301 00	18410	1
A1R21	Res, 3240 ohms ±1%, 1/10 W, 125° C, film	511 33241 00	18410	1
A1R22	Res, 15 k ohms ±1%, 1/10 W, 125° C, film	511 31502 00	18410	1
A1R23	Res, 2740 ohms ±1%, 1/10 W, 125° C, film	511 32741 00	18410	1
A1S1	Switch, rotary, 4-pole, 9-pos, 4-deck	720 00030 00	18410	1
A1S2	Switch, rotary, 4-pole, 11-pos, 4-deck	720 00022 00	18410	1
A1S3	Switch, toggle, dpdt	722 00001 00	18410	1
A1T1	Transformer, input, 1:1 turns ratio, 9.0 ohms ±10% dc resistance	700 00013 01	18410	1

PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	CAL-OSC ASSEMBLY A2			
A2	Circuit Card Assembly, Calibrate Osc.	110 00027 00	18410	
A2C1	Cap, 15 pF ±5%, 500 wvdc, silver mica	DM15C150J	72136	1
A2C2	Cap, 0.01 uF ±20%, 200 wvdc, disc ceramic	0805030Z5U00 103M	72982	1
A2C3	Cap, 470 pF ±5%, 500 wvdc, silver mica	DM19E471J	72136	1
A2C4	NOT USED			
A2C5	Cap, 10 uF ±20%, 10 wvdc, tantalum	B45134-J3106 -S4	25088	2
A2C6	Cap, 0.1 uF (-20%, +80%), 25 wvdc, disc ceramic	5815000Y5U00 104Z	72982	1
A2C7	Cap, 10 uF, same as A2C5			
A2C8	Cap, 250 pF ±5%, 500 wvdc, silver mica	DM15E251J	72136	1
A2C9	Cap, 0.1 uF ±10%, 200 wvdc, mylar	210B1C104K	14752	1
A2CR1	Diode, silicon	1N914	01295	2
A2CR2	Diode, same as A2CR1			
A2L1	Coil, rf, 1.0 mH, 34 ohms dc resistance	U102	99848	1
A2Q1	Transistor, silicon, N-Channel, FET	400 00001 00	18410	1
A2Q2	Transistor, silicon, NPN, selected 2N3710	400 00002 01	18410	2
A2Q3	Transistor, silicon, PNP	2N4058	01295	1
A2Q4	Transistor, same as A2Q2			
A2R1	Res, 10 k ohms ±5%, 1/2 W, carbon	502 00103 00	18410	2
A2R2	Res, 1 megohm ±5%, 1/2 W, carbon	502 00105 00	18410	1
A2R3	Res, 680 ohms ±5%, 1/2 W, carbon	502 00681 00	18410	1
A2R4	Res, 390 ohms ±5%, 1/2 W, carbon	502 00391 00	18410	1
A2R5	Res, 1500 ohms ±5%, 1/2 W, carbon	502 00152 00	18410	1
A2R6	Res, 68 ohms ±5%, 1/2 W, carbon	502 00680 00	18410	1
A2R7	Res, 3300 ohms ±5%, 1/2 W, carbon	502 00332 00	18410	1
A2R8	Res, 2200 ohms ±5%, 1/2 W, carbon	502 00222 00	18410	1
A2R9	NOT USED			
A2R10	Res, 33 k ohms ±5%, 1/2 W, carbon	502 00333 00	18410	1
A2R11	Res, 10 k ohms, same as A2R1			
A2R12	Res, var, 500 ohms ±20%, 1/2 W	362X501B	11236	1
A2R13	Res, 100 ohms ±5%, 1/2 W, carbon	502 00101 00	18410	1
A2R14	Res, 1100 ohms ±5%, 1/2 W, carbon	502 00112 00	18410	1
A2R15	Res, 150 ohms ±5%, 1/2 W, carbon	502 00151 00	18410	1
A2Y1	Crystal, 250.0000 kHz	Type CR-46A /U	13571	1

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	I-F ASSEMBLY A4			
A4	Circuit Card Assembly, I-F	110 00020 00	18410	
A4C1	Cap, 0.01 uF ±20%, 200 wvdc, disc ceramic	0805030Z5U00 103M	72982	6
A4C2	Cap, 0.1 uF (-20%, +80%), 25 wvdc disc ceramic	5815000Y5U00 104Z	72982	10
A4C3	Cap, 0.1 uF ±10%, 200 wvdc, mylar	210B1C104K	14752	4
A4C4	Cap, 0.1 uF, same as A4C2			
A4C5	Cap, 0.1 uF, same as A4C2			
A4C6	Cap, 0.01 uF, same as A4C1			
A4C7	Cap, var, 5-25 pF, 350 wvdc, NPO, ceramic	05570051C0P0 39R	72982	4
A4C8	Cap, var, 5-25 pF, same as A4C7			
A4C9	Cap, var, 5-25 pF, same as A4C7			
A4C10	Cap, var, 5-25 pF, same as A4C7			
A4C11	Cap, 68 pF ±5%, 500 wvdc, silver mica	DM15E680J	72136	1
A4C12	Cap, 0.01 uF, same as A4C1			
A4C13	Cap, 0.1 uF, same as A4C3			
A4C14	Cap, 0.1 uF, same as A4C2			
A4C15	Cap, 0.1 uF, same as A4C2			
A4C16	Cap, 0.01 uF, same as A4C1			
A4C17	Cap, 0.1 uF, same as A4C3			
A4C18	Cap, 0.1 uF, same as A4C2			
A4C19	Cap, 0.1 uF, same as A4C2			
A4C20	Cap, 0.1 uF, same as A4C2			
A4C21	Cap, 0.01 uF, same as A4C1			
A4C22	Cap, 0.1 uF, same as A4C3			
A4C23	Cap, 0.1 uF, same as A4C2			
A4C24	Cap, 0.1 uF, same as A4C2			
A4C25	Cap, 0.01 uF, same as A4C1			
A4CR1	Diode, germanium	1N277	03877	1
A4FL1	Filter, bandpass, 2215 kHz, 50-Hz BW (used in units with 50-Hz selectivity)	760 00007 00	18410	1
A4FL1	Filter, bandpass, 2215 kHz, 100-Hz BW (used in units with 100-Hz selectivity	760 00006 00	18410	1
A4FL1	Filter, bandpass, 2215 kHz, 250-Hz BW (used in units with 250-Hz selectivity	760 00005 00	18410	1
A4FL2	Filter bandpass, 2215 kHz, 2500-Hz BW	760 00004 00	18410	1
A4L1	Coil, rf, 1.0 mH, 34 ohms dc resistance	U102	99848	3
A4L2	Coil, rf, 1.0 mH, same as A4L1			
A4L3	Coil, rf, 1.0 mH, same as A4L1			

PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	I-F ASSEMBLY A4 (cont)			
A4Q1	Transistor, silicon, NPN	2N4124	04713	6
A4Q2	Transistor, same as A4Q1			
A4Q3	Transistor, silicon, NPN, selected 2N3710	400 00002 01	18410	2
A4Q4	Transistor, same as A4Q1			
A4Q5	Transistor, same as A4Q1			
A4Q6	Transistor, same as A4Q1			
A4Q7	Transistor, same as A4Q1			
A4Q8	Transistor, same as A4Q3			
A4R1	Res, 200 ohms ±5%, 1/2 W, carbon	502 00201 00	18410	1
A4R2	Res, 6200 ohms ±5%, 1/2 W, carbon	502 00622 00	18410	1
A4R3	Res, 4300 ohms ±5%, 1/2 W, carbon	502 00432 00	18410	1
A4R4	Res, 10 k ohms ±5%, 1/2 W, carbon	502 00103 00	18410	7
A4R5	Res, var, 200 ohms ±20%, 1/2 W, cermet	362Y201B	11236	1
A4R6	Res, 390 ohms ±5%, 1/2 W, carbon	502 00391 00	18410	4
A4R7	Res, 10 k ohms, same as A4R4			
A4R8	Res, 2700 ohms ±5%, 1/2 W, carbon	502 00272 00	18410	2
A4R9	Res, 3900 ohms ±5%, 1/2 W, carbon	502 00392 00	18410	2
A4R10	Res, 390 ohms, same as A4R6			
A4R11	Res, 680 ohms ±5%, 1/2 W, carbon	502 00681 00	18410	2
A4R12	Res, 1100 ohms ±5%, 1/2 W, carbon	502 00112 00	18410	1
A4R13	Res, 47 k ohms ±5%, 1/2 W, carbon	502 00473 00	18410	1
A4R14	Res, 18 k ohms ±5%, 1/2 W, carbon	502 00183 00	18410	1
A4R15	Res, 10 k ohms, same as A4R4			
A4R16	Res, 3900 ohms, same as A4R9			
A4R17	Res, 1000 ohms ±5%, 1/2 W, carbon	502 00102 00	18410	3
A4R18	NOT USED			
A4R19	Res, 10 k ohms, same as A4R4			
A4R20	Res, 4700 ohms ±5%, 1/2 W, carbon	502 00472 00	18410	1
A4R21	Res, 1000 ohms, same as A4R17			
A4R22	Res, 10 k ohms, same as A4R4			
A4R23	Res, 2200 ohms ±5%, 1/2 W, carbon	502 00222 00	18410	1
A4R24	Res, 390 ohms, same as A4R6			
A4R25	Res, 10 k ohms, same as A4R4			
A4R26	Res, 27 k ohms ±5%, 1/2 W, carbon	502 00273 00	18410	1
A4R27	Res, 1000 ohms, same as A4R17			
A4R28	Res, 10 k ohms, same as A4R4			
A4R29	Res, 3300 ohms ±5%, 1/2 W, carbon	502 00332 00	18410	1
A4R30	Res, 2700 ohms, same as A4R8			
A4R31	Res, 390 ohms, same as A4R6			
A4R32	Res, 680 ohms, same as A4R11			
A4R33	Res, Selected as required	Type 502	18410	1
A4R34	Res, 10 k ohms ±5%, 1/2 W, carbon	502 00103 00	18410	1

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	I-F ASSEMBLY A4 (cont)			
A4S4	Switch, rotary, detent only	720 00019 00	18410	1
A4S4	Switch, rotary, wafer only	720 00019 01	18410	1
A4T1	Transformer, I-F, 2215 kHz	700 00004 00	18410	3
A4T2	Transformer, same as A4T1			
A4T3	Transformer, same as A4T1			

PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	DEMODULATOR ASSEMBLY A5			
A5	Circuit Card Assembly, Demodulator	110 00023 02	18410	
A5C1	Cap, 10 uF (-10%, +10%), 15 wvdc, electrolytic	30D106G015 BA2	56289	1
A5C2	NOT USED			
A5C3	Cap, 22 uF ±20%, 15 wvdc, tantalum	T110B-226M -015AS	05397	1
A5C4	Cap, 200 pF ±5%, 500 wvdc, silver mica	DM15E201J	72136	1
A5C5	Cap, 0.1 uF (-20%, +80%), 25 wvdc disc ceramic	5815000Y5U00 104Z	72982	3
A5C6	Cap, 59 pF ±5%, 500 wvdc, silver mica	DM15E590J	72136	1
A5C7	Cap, 0.01 uF ±20%, 200 wvdc, disc ceramic	0805030Z5U00 103M	72982	5
A5C8	Cap, 0.01 uF, same as A5C7			
A5C9	Cap, 0.01 uF, same as A5C7			
A5C10	Cap, 0.01 uF, same as A5C7			
A5C11	Cap, 0.1 uF, same as A5C5			
A5C12	Cap, 5 uF (-10%, +100%), 15 wvdc electrolytic	B41313	25088	2
A5C13	Cap, 0.01 uF, same as A5C7			
A5C14	Cap, 0.1 uF, same as A5C5			
A5C15	Cap, 270 pF ±20%, 500 wvdc disc ceramic	JE270pFX5F	91418	1
A5C16	Cap, 5 uF, same as A5C12			
A5C17	Cap, 100 pF ±20%, 500 wvdc, disc ceramic	JL100pFX5F	91418	1
A5C18	Cap, 500 uF (-10%, +100%), 25 wvdc aluminum electrolytic	JA13-500-25 -8P	29309	1
A5C19	Cap, 22 uF, (-10%, +100%), 25 wvdc electrolytic	B411316	25088	1
A5CR1	NOT USED			
A5CR2	Diode, germanium	1N277	03877	2
A5CR3	Diode, same as A5CR2			
A5IC1	Integrated Circuit	MFC8010	04713	1
A5L1	Coil, rf, 1.0 mH	U102	99848	1
A5Q1	Transistor, silicon, NPN	2N3053	79089	1
A5Q2	Transistor, silicon, NPN, selected 2N3710	400 00002 01	18410	3
A5Q3	Transistor, same as A5Q2			
A5Q4	Transistor, same as A5Q2			

PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	DEMODULATOR ASSEMBLY A5 (cont)			
A5R1	Res, 1000 ohms ±5%, 1/2 W, carbon	502 00102 00	18410	4
A5R2	Res, 820 ohms ±5%, 1/2 W, carbon	502 00821 00	18410	1
A5R3	NOT USED			
A5R4	Res, 60.4 k ohms ±1%, 1/8 W, 125° C	511 46042 00	18410	1
A5R5	Res, 10 k ohms ±5%, 1/2 W, carbon	502 00103 00	18410	3
A5R6	Res, 2000 ohms ±5%, 1/2 W, carbon	502 00202 00	18410	1
A5R7	Res, 4700 ohms ±5%, 1/2 W, carbon	502 00472 00	18410	3
A5R8	Res, 1000 ohms, same as A5R1			
A5R9	Res, 8200 ohms ±5%, 1/2 W, carbon	502 00822 00	18410	1
A5R10	Res, 2200 ohms ±5%, 1/2 W, carbon	502 00222 00	18410	2
A5R11	Res, 1000 ohms, same as A5R1			
A5R12	Res, 1000 ohms, same as A5R1			
A5R13	Res, 4700 ohms, same as A5R7			
A5R14	Res, 4700 ohms, same as A5R7			
A5R15	Res, 1500 ohms ±5%, 1/2 W, carbon	502 00152 00	18410	1
A5R16	Res, 3900 ohms ±5%, 1/2 W, carbon	502 00392 00	18410	1
A5R17	Res, 10 k ohms, same as A5R5			
A5R18	Res, 1 megohm ±5%, 1/2 W, carbon	502 00105 00	18410	1
A5R19	Res, 1.2 megohm ±5%, 1/2 W, carbon	502 00125 00	18410	1
A5R20	Res, 2200 ohms, same as A5R10			
A5R21	Res, 10 k ohms, same as A5R5			
A5R22	Res, 51 k ohms ±5%, 1/2 W, carbon	502 00513 00	18410	1
A5R23	Res, 100 ohms ±5%, 1/2 W, carbon	502 00101 00	18410	1
A5S5	Switch, rotary, detent only	720 00021 00	18410	1
A5S5	Switch, rotary, wafer only	720 00021 01	18410	1
VR1	Diode, Zener, ±1%, 1 W	SZ9.1	81071	1
A5Y1	Crystal, 2213.5 kHz	765 00003 00	18410	1
A5Y2	Crystal, 2216.5 kHz	765 00004 00	18410	1

PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	DISPLAY INPUT ASSEMBLY A8			
A8	Circuit Card Assembly, Display Input	110 00065 00	18410	
A8C1	Cap, Var, 15-60 pF, 200 wvdc, N1500, cer	DV11PR60Q	73899	1
A8C2	Cap, 200 pF ±5%, 100 wvdc, mica	DM15A201J	72136	1
A8C3	Cap, 110 pF ±5%, 100 wvdc, mica	DM15A111J	72136	2
A8C4	Cap, .01 uF ±20%, 100 wvdc, disc ceramic	0805000Z5U00 103M	72982	6
A8C5	Cap, .01 uF, same as A8C4			
A8C6	Cap, .01 uF, same as A8C4			
A8C7	Cap, .01 uF, same as A8C4			
A8C8	Cap, .01 uF, same as A8C4			
A8C9	Cap, .01 uF, same as A8C4			
A8C10	Cap, 110 pF, same as A8C3			
A8C11	Cap, 0.1 uF +80,-10%, 25 wvdc, disc ceramic	5815000Y5U00 104Z	72982	1
A8I1	Integrated Circuit	LM703LN	27014	1
A8I2	Integrated Circuit	LM311N	27014	1
A8I3	Integrated Circuit	LM358N	27014	1
A8P1	Connector, 7 Pin W/Carrier Strip	812 00020 07	18410	1
A8Q1	Transistor, NPN	2N4997	01295	2
A8Q2	Transistor, NPN, same as A8Q1			
A8Q3	Transistor, PNP	2N5910	07263	1
A8Q4	Transistor, NPN	2N3704	01295	2
A8Q5	Transistor, same as A8Q4			
A8R1	Res, 39 k ohms ±5%, 1/4 W, carbon	500 00393 00	18410	1
A8R2	Res, 15 k ohms ±5%, 1/4 W, carbon	500 00153 00	18410	1
A8R3	Res, 6800 ohms ±5%, 1/4 W, carbon	500 00682 00	18410	1
A8R4	Res, 1100 ohms ±5%, 1/4 W, carbon	500 00112 00	18410	2
A8R5	Res, 1100 ohms, same as A8R4			
A8R6	Res, 3600 ohms ±5%, 1/4 W, carbon	500 00362 00	18410	2
A8R7	Res, 470 ohms ±5%, 1/4 W, carbon	500 00471 00	18410	2
A8R8	Res, 1000 ohms ±5%, 1/4 W, carbon	500 00102 00	18410	2
A8R9	Res, 1000 ohms, same as A8R8			
A8R10	Not Used			
A8R11	Res, 470 ohms, same as A8R7			
A8R12	Res, 2000 ohms ±5%, 1/4 W, carbon	500 00202 00	18410	2
A8R13	Res, 3600 ohms, same as A8R6			

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REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	DISPLAY INPUT ASSEMBLY A8 (cont)			
A8R14	Res, 200 k ohms ±5%, 1/4 W, carbon	500 00204 00	18410	2
A8R15	Res, 200 k ohms, same as A8R14			
A8R16	Res, 10 k ohms ±5%, 1/4 W, carbon	500 00103 00	18410	2
A8R17	Res, 10 k ohms, same as A8R16			
A8R18	Res, 10 Meg ohms ±5%, 1/4 W, carbon	500 00106 00	18410	1
A8R19	Res, 2000 ohms, same as A8R12			
A8R20	Res, Var, 2 Meg ohm ±20%, cermet	3389W1-205	80294	1
A8R21	Res, 200 ohms ±5%, 1/4 W, carbon	500 00201 00	18410	1
A8Y1	Crystal, Quartz, 2205.000 kHz ±.005%	765 00005 00	18410	1

PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	DISPLAY TIMING ASSEMBLY A9			
A9	Circuit Card Assembly, Display Timing	110 00066 00	18410	
A9C1	Cap, 0.1 uF ±20%, 100 wvdc, disc ceramic	8131-M100-651 -104M	72982	3
A9C2	Cap, 10 uF ±20%, 16 wvdc, tantalum	Type TAG	29505	3
A9C3	Cap, 0.1 uF, same as A9C1			
A9C4	Cap, 10 uF, same as A9C2			
A9C5	Cap, 0.1 uF, same as A9C1			
A9C6	Cap, 10 uF, same as A9C2			
A9I1	Integrated Circuit	MC14013CP	04713	6
A9I2	Integrated Circuit, same as A9I1			
A9I3	Integrated Circuit	MC14001CP	04713	1
A9I4	Integrated Circuit	MC14017CP	04713	2
A9I5	Integrated Circuit, same as A9I1			
A9I6	Integrated Circuit, same as A9I1			
A9I7	Integrated Circuit, same as A9I4			
A9I8	Integrated Circuit	MC14023CP	04713	1
A9I9	Integrated Circuit	MC14507CP	04713	1
A9I10	Integrated Circuit, same as A9I1			
A9I11	Integrated Circuit	MC14040CP	04713	1
A9I12	Integrated Circuit, same as A9I1			
A9J1	Connector, 7 Pin W/Carrier Strip	812 00020 07	18410	1
A9P1	Connector, 9 Pin W/Carrier Strip	812 00019 09	18410	1
A9Q1	Transistor, NPN, Darlington	2N5308	03508	1
A9R1	Res, 10 k ohms ±5%, 1/4 W, carbon	500 00103 00	18410	2
A9R2	Res, 10 k ohms, same as A9R1			
A9R3	Res, 200 k ohms ±5%, 1/4 W, carbon	500 00204 00	18410	1

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PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	DISPLAY READOUT ASSEMBLY A10			
A10	Circuit Card Assembly, Display Readout	110 00067 00	18410	
A10C1	Cap, 100 pF ±20%, 500 wvdc, disc ceramic	JL100pf±20% 500WVDCX5F	91418	1
A10C2	Cap, 22 uF ±20%, 15 wvdc, tantalum	T110B-226M 015AS	05397	2
A10C3	Cap, 22 uF, same as A10C2			
A10CR1	Diode, silicon	1N914	01295	15
A10CR2	Diode, same as A10CR1			
A10CR3	Diode, same as A10CR1			
A10CR4	Diode, same as A10CR1			
A10CR5	Diode, same as A10CR1			
A10CR6	Diode, same as A10CR1			
A10CR7	Diode, same as A10CR1			
A10CR8	Diode, same as A10CR1			
A10CR9	Diode, same as A10CR1			
A10CR10	Diode, same as A10CR1			
A10CR11	Diode, same as A10CR1			
A10CR12	Diode, same as A10CR1			
A10CR13	Diode, same as A10CR1			
A10CR14	Diode, same as A10CR1			
A10CR15	Diode, same as A10CR1			
A10I1	Integrated Circuit, 4553	430 00002 00	18410	2
A10I2	Integrated Circuit	MC14543CP	04713	2
A10I3	Integrated Circuit, MAN3620	430 00003 00	18410	6
A10I4	Integrated Circuit, same as A10I3			
A10I5	Integrated Circuit, same as A10I3			
A10I6	Integrated Circuit, same as A10I1			
A10I7	Integrated Circuit, same as A10I2			
A10I8	Integrated Circuit, same as A10I3			
A10I9	Integrated Circuit, same as A10I3			
A10I10	Integrated Circuit, same as A10I3			
A10J1	Connector, 9 Pin W/Carrier Strip	812 00019 09	18410	1
A10Q1	Transistor, PNP	2N5910	07263	3
A10Q2	Transistor, same as A10Q1			
A10Q3	Transistor, same as A10Q1			
A10R1	Res, 2700 ohms ±5%, 1/4 W, carbon	500 00272 00	18410	3
A10R2	Res, 2700 ohms, same as A10R1			
A10R3	Res, 2700 ohms, same as A10R1			
A10R4	Res, 390 ohms ±5%, 1/4 W, carbon	500 00391 00	18410	1

PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	DISPLAY ASSEMBLY A11			
	The Display Assembly A11 consists of A8, A9, A10 and the following:			
A11C1	Cap, Feed-thru, 1000 pF ±20%, mica	680 00002 00	18410	2
A11C2	Cap, 1000 pF, same as A11C1			
A11C3	Cap, Feed-thru, 1000 pF ±20%, mica	680 00001 00	18410	2
A11C4	Cap, 1000 pF, same as A11C3			
A11DS1	Lamp, Indicator	742 00001 04	18410	2
A11DS2	Lamp, same as A11DS1			
A11J1	Jack, Phono	812 00007 00	18410	2
A11J2	Jack, same as A11J1			

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	CHARGING CONTROL ASSEMBLY A12			
A12	Circuit Card Assembly, Charging Control	110 00068 00	18410	
A12CR1	Diode, 3 junction stabister	STB568	03508	1
A12CR2	Rectifier, Bridge, 100 PRV, 1.0 A	CB80	83701	1
A12CR3	Diode, silicon	1N914	01295	1
A12Q1	Transistor, NPN	2N3704	01295	1
A12Q2	Transistor, PNP	2N3702	01295	1
A12Q3	Transistor, NPN	2N5294	79089	1
A12R1	Res, 100 ohms ±5%, 1/2 W, carbon	502 00101 00	18410	1
A12R2	Res, 4 ohms ±5%, 3.0-3.75 W, wire wound	CW-2B	91637	1
A12R3	Res, Var, 500 ohms ±20%, cermet	3389T501	80294	1
A12R4	Res, 210 ohms ±1%, 1/4 W, 70° C, film	511 42100 00	18410	1
A12R5	Res, 294 ohms ±1%, 1/4 W, 70° C, film	511 42940 00	18410	1
A12R6	Res, 340 ohms ±1%, 1/4 W, 70° C, film	511 43400 00	18410	1
A12R7	Res, 2200 ohms ±5%, 1/4 W, carbon	500 00222 00	18410	1
A12R8	Res, 15 k ohms ±5%, 1/4 W, carbon	500 00153 00	18410	1
A12R9	Res, 470 ohms ±5%, 1/4 W, carbon	500 00471 00	18410	1
A12RT1	Thermistor, 100 ohms	LB21J1	15801	1

PARTS LIST

REF DES	DESCRIPTION	PART NO.	MFR	QTY/ ASSY
	POWER SUPPLY ASSEMBLY A13			
A13C1	Cap, 250 uF +100,-10%, 50 wvdc, Elect'c	B41010 250 /50Y	25088	1
A13C2	Cap, 0.1 uF +80,-20%, 25 wvdc, disc ceramic	5815000Y5U00 104Z	72982	1
A13CR1	Rectifier, Bridge, 200 PIV, 2 A	S6230	84970	1
A13I1	Integrated Circuit	LM309K	27014	1
A13T1	Transformer, Power, 115 VAC (used in units with 115 vac operation)	700 00026 00	18410	1
A13T1	Transformer, Power, 220 VAC (used in units with 220 vac operation)	700 00026 01	18410	1

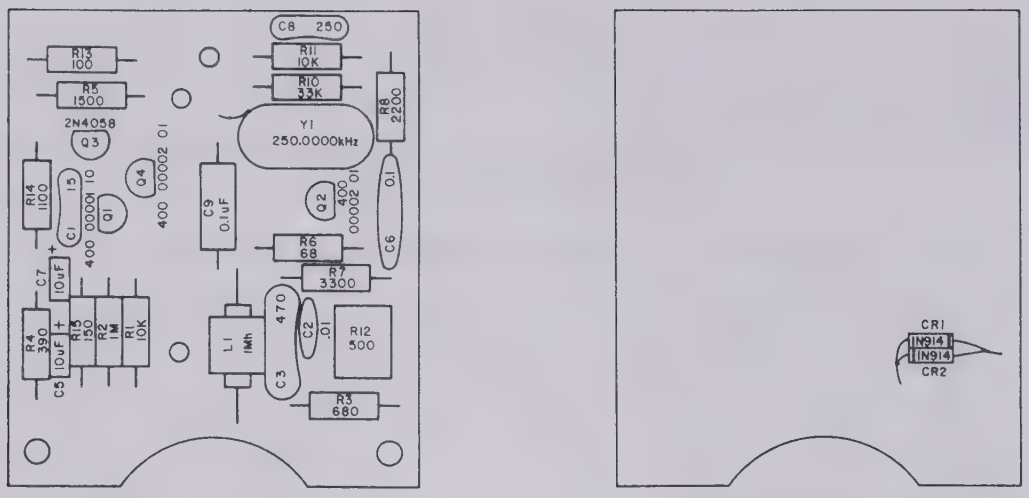

Figure 5. Cal-Osc Assembly A2

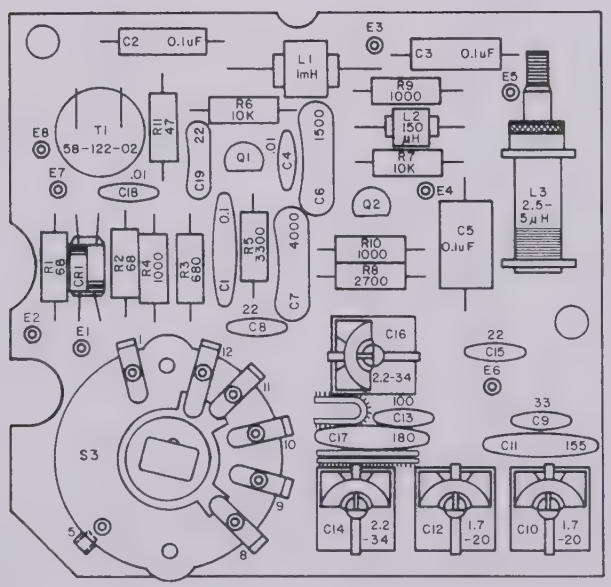

Figure 6. Local Oscillator Assembly A3

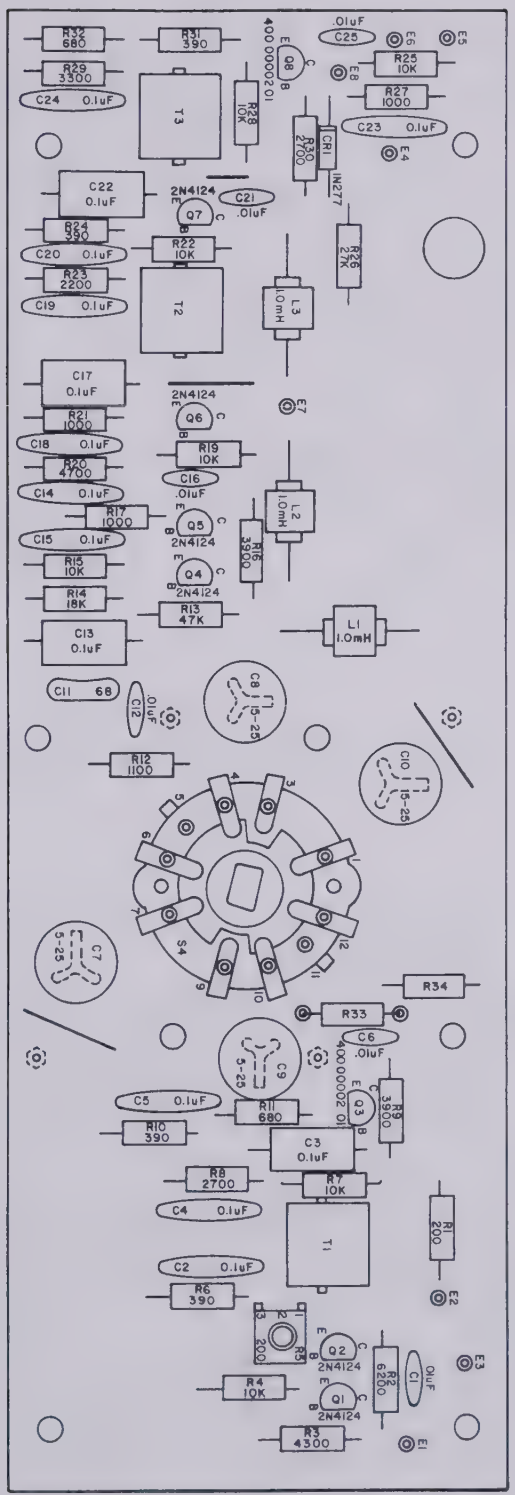

Figure 7. I-F Assembly A4

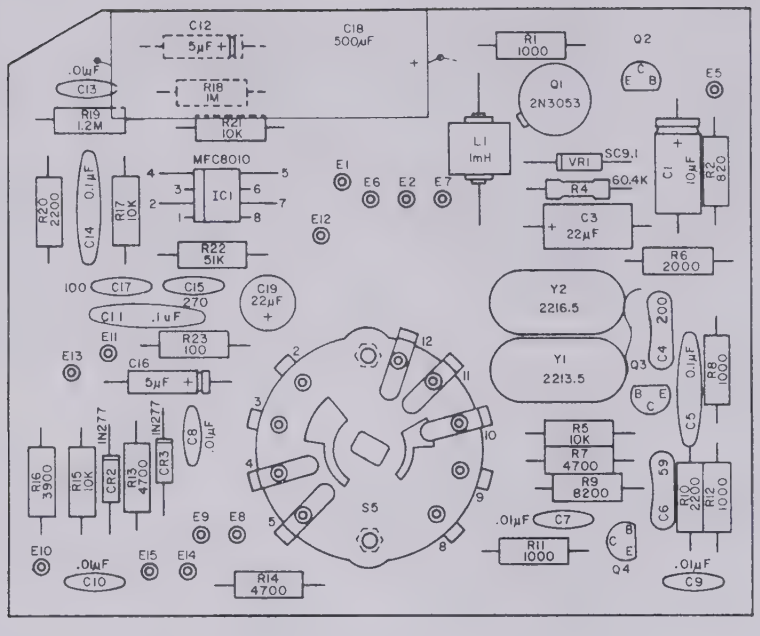

Figure 8. Demodulator Assembly A5

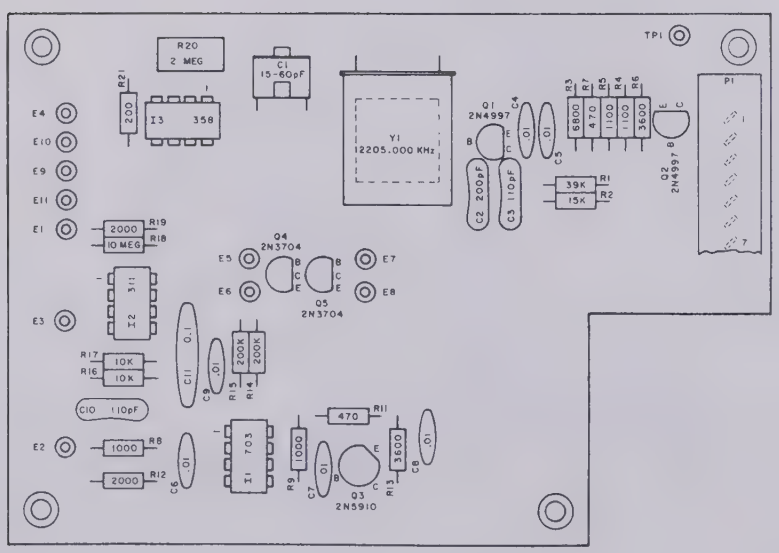

Figure 9. Display Input Assembly A8

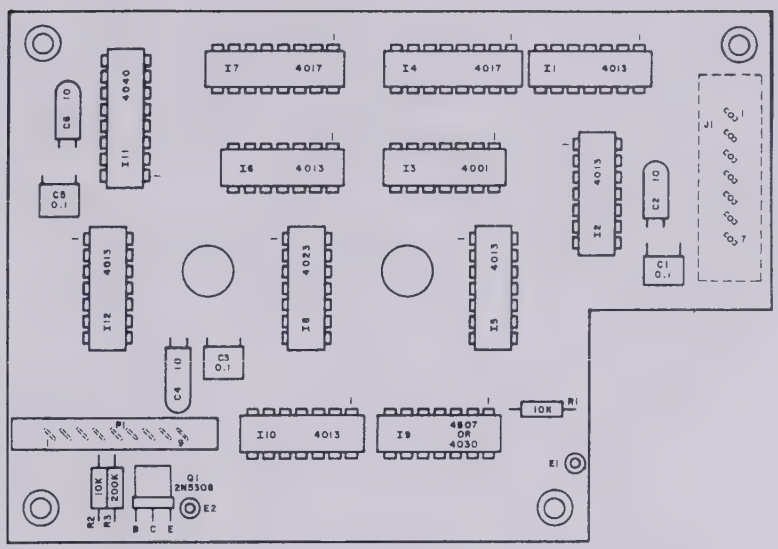

Figure 10. Display Timing Assembly A9

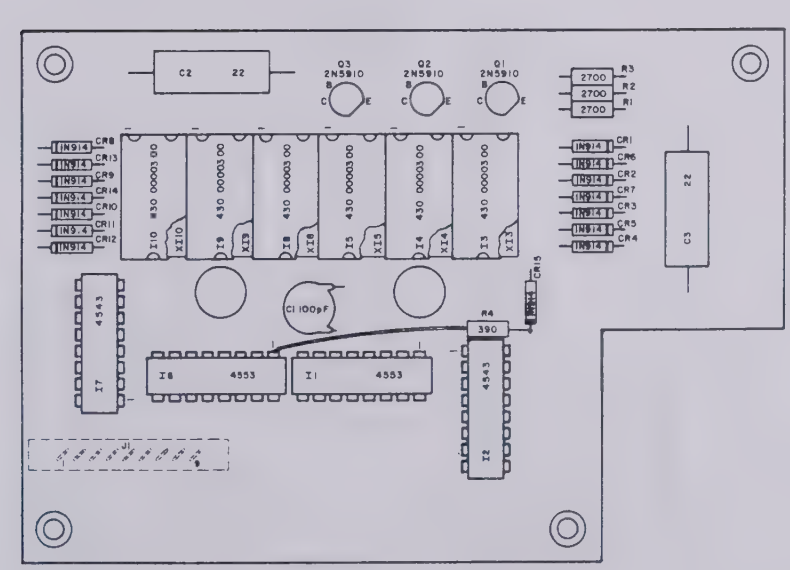

Figure 11. Display Readout Assembly A10

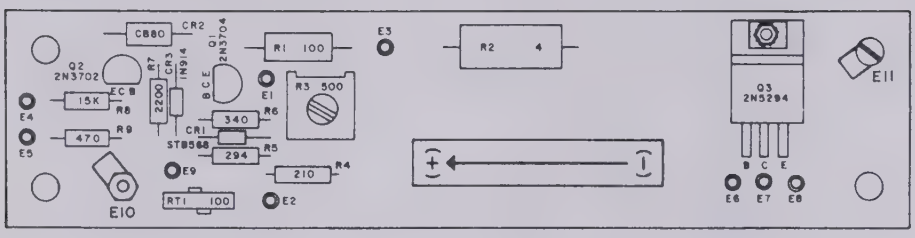

Figure 12. Charging Control Assembly A12

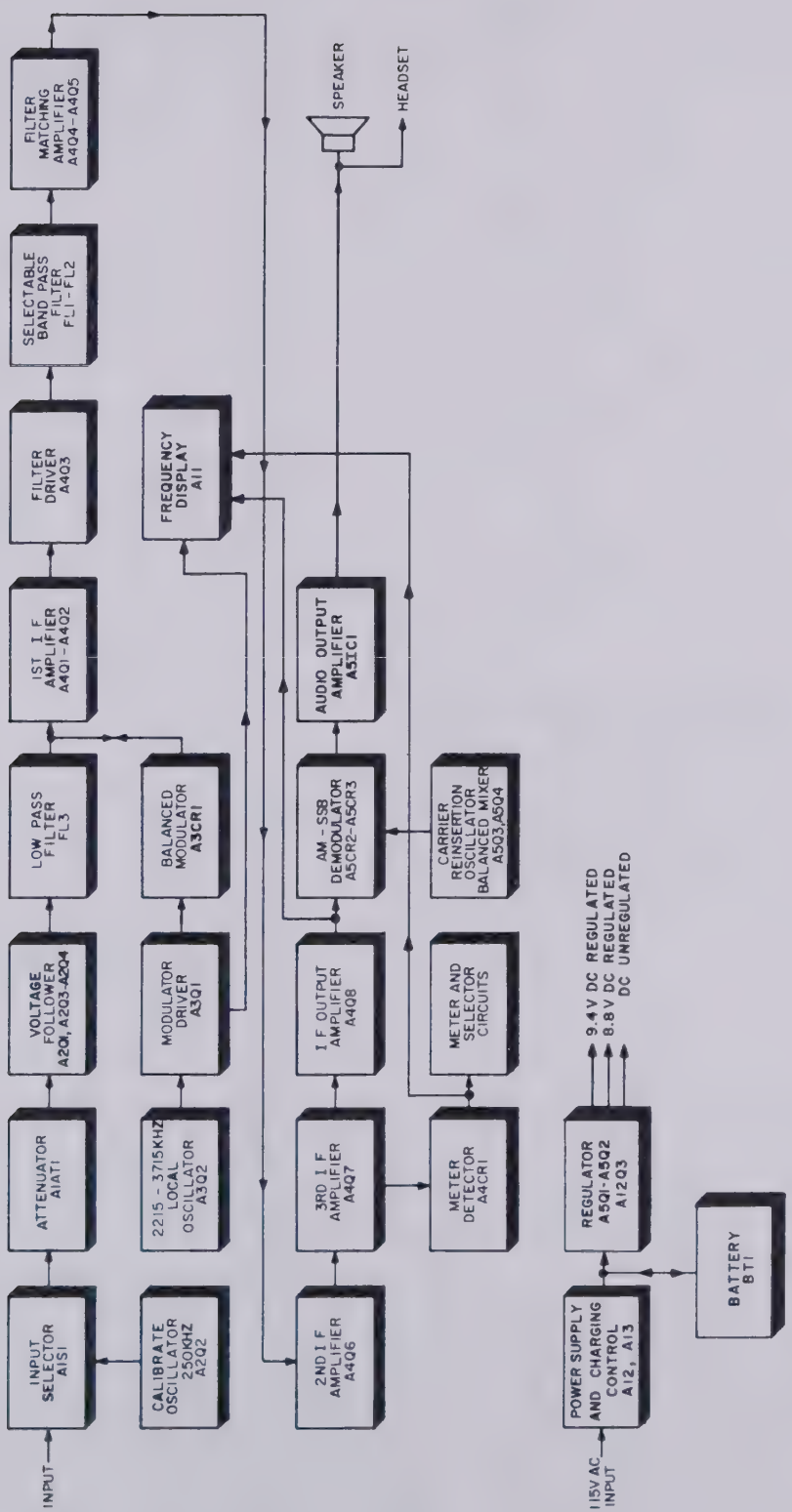

Figure 13. Block Diagram

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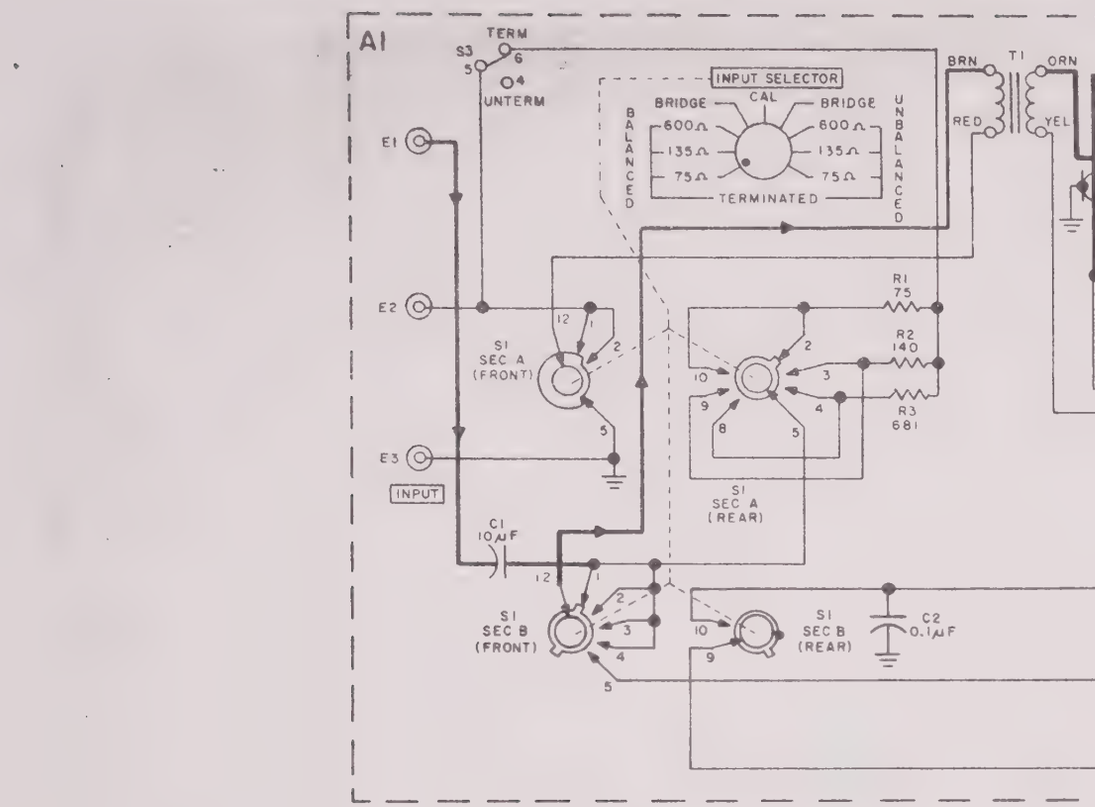

ATTENUATOR AT1
PART OF MODULE A1 ABOVE

DWG. NO. 032 00073 00
REV. 5-19-76
SER. NO 101-

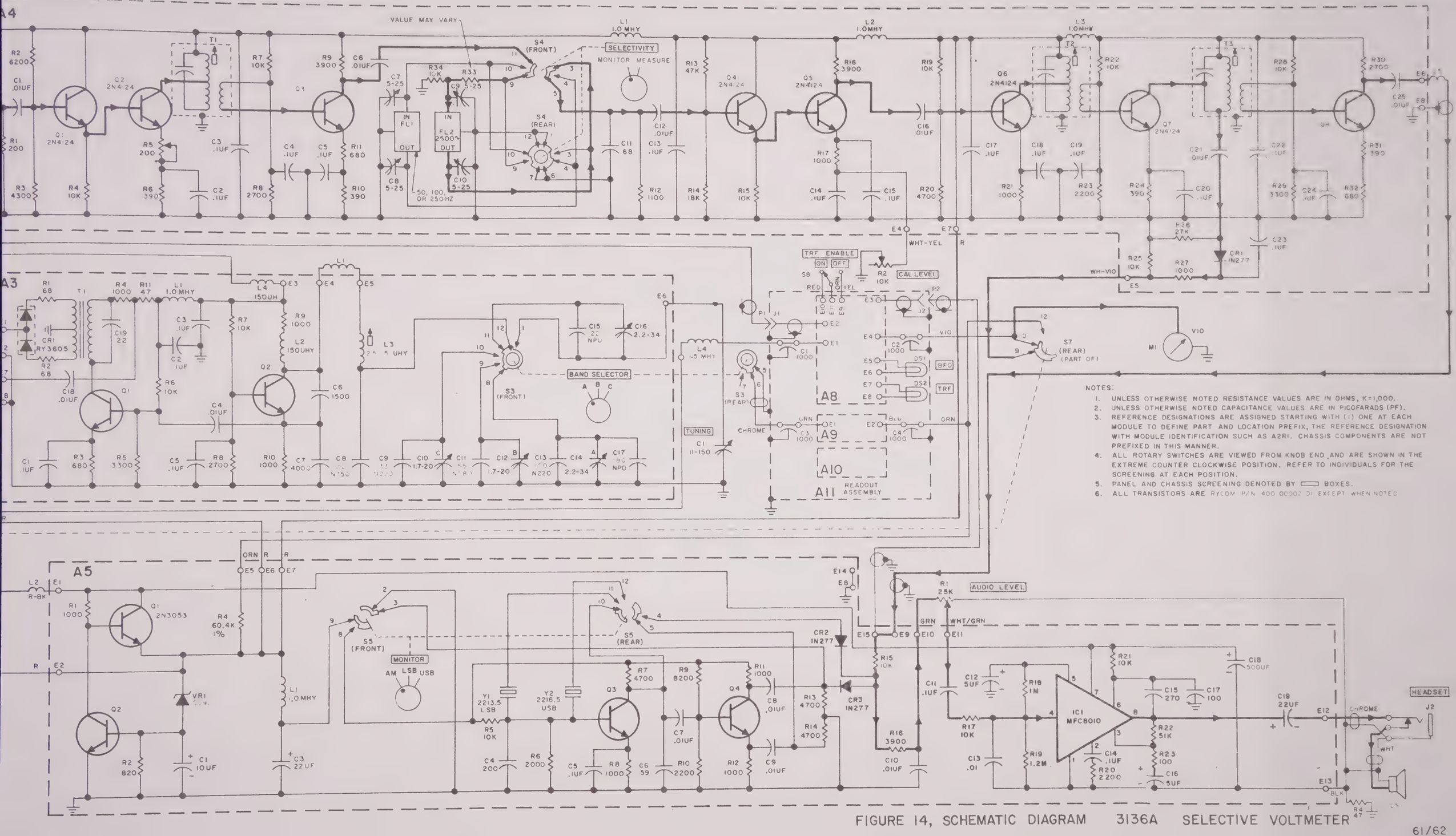
A4
A3
A5
A8
A9
A10
A11
READOUT ASSEMBLY
VALUE MAY VARY
SELECTIVITY
MONITOR MEASURE
BAND SELECTOR
TUNING
TRF ENABLE
CAL LEVEL
AUDIO LEVEL
MONITOR
BFO
TRF
HEADSET
NOTES:
1. UNLESS OTHERWISE NOTED RESISTANCE VALUES ARE IN OHMS, K=1,000.
2. UNLESS OTHERWISE NOTED CAPACITANCE VALUES ARE IN PICOFARADS (PF).
3. REFERENCE DESIGNATIONS ARE ASSIGNED STARTING WITH (1) ONE AT EACH MODULE TO DEFINE PART AND LOCATION PREFIX, THE REFERENCE DESIGNATION WITH MODULE IDENTIFICATION SUCH AS A2R1. CHASSIS COMPONENTS ARE NOT PREFIXED IN THIS MANNER.
4. ALL ROTARY SWITCHES ARE VIEWED FROM KNOB END AND ARE SHOWN IN THE EXTREME COUNTER CLOCKWISE POSITION. REFER TO INDIVIDUALS FOR THE SCREENING AT EACH POSITION.
5. PANEL AND CHASSIS SCREENING DENOTED BY ▭ BOXES.
6. ALL TRANSISTORS ARE RYCOM P/N 400 00002 01 EXCEPT WHEN NOTED

FIGURE 14, SCHEMATIC DIAGRAM 3136A SELECTIVE VOLTMETER

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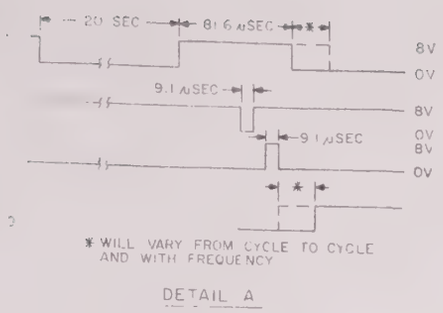
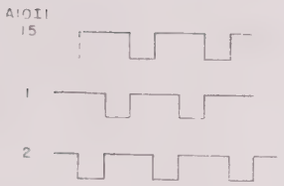
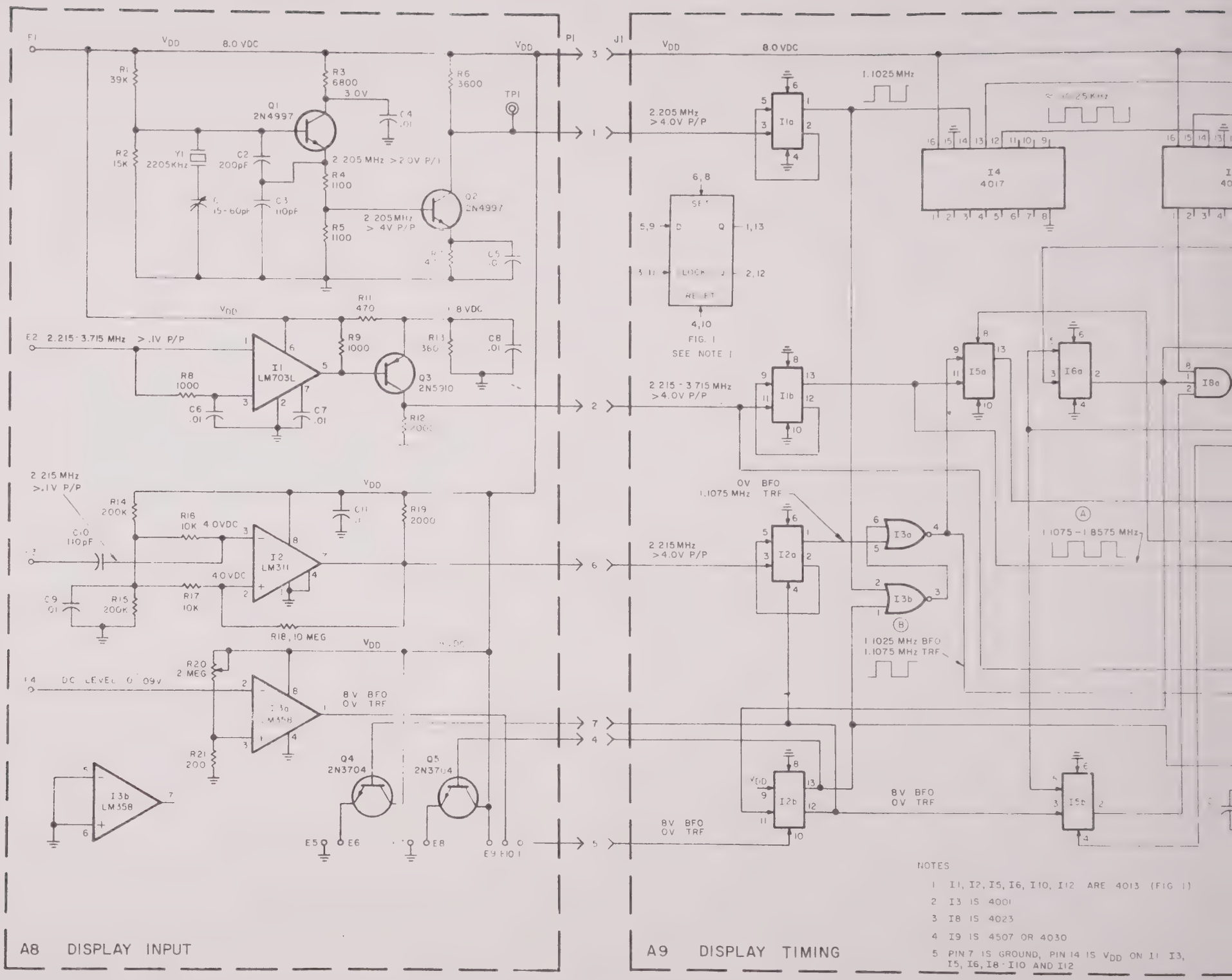


DETAIL A



DETAIL B

DWG. NO. 032 00074 00
ORIG 5-19-76 GLB
SER NO 101-



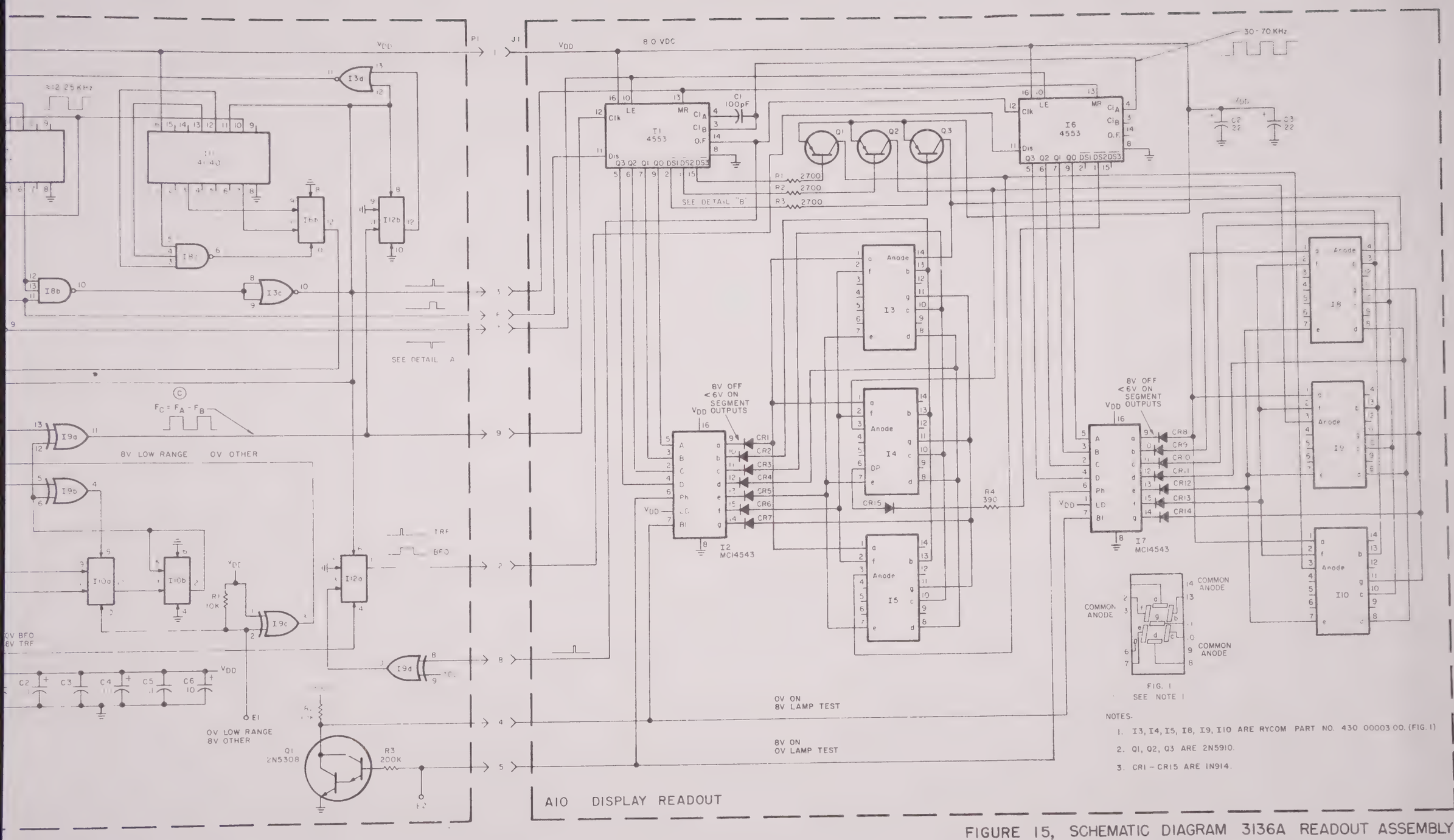

A10 DISPLAY READOUT
SEE DETAIL A
SEE DETAIL B
8V LOW RANGE 0V OTHER
0V LOW RANGE 8V OTHER
0V ON 8V LAMP TEST
8V ON 0V LAMP TEST
8V OFF <6V ON SEGMENT OUTPUTS
COMMON ANODE
NOTES:
1. I3, I4, I5, I8, I9, I10 ARE RYCOM PART NO. 430 00003 00. (FIG. 1)
2. Q1, Q2, Q3 ARE 2N5910.
3. CR1 – CR15 ARE IN914.

FIG. 1 SEE NOTE 1

FIGURE 15, SCHEMATIC DIAGRAM 3136A READOUT ASSEMBLY

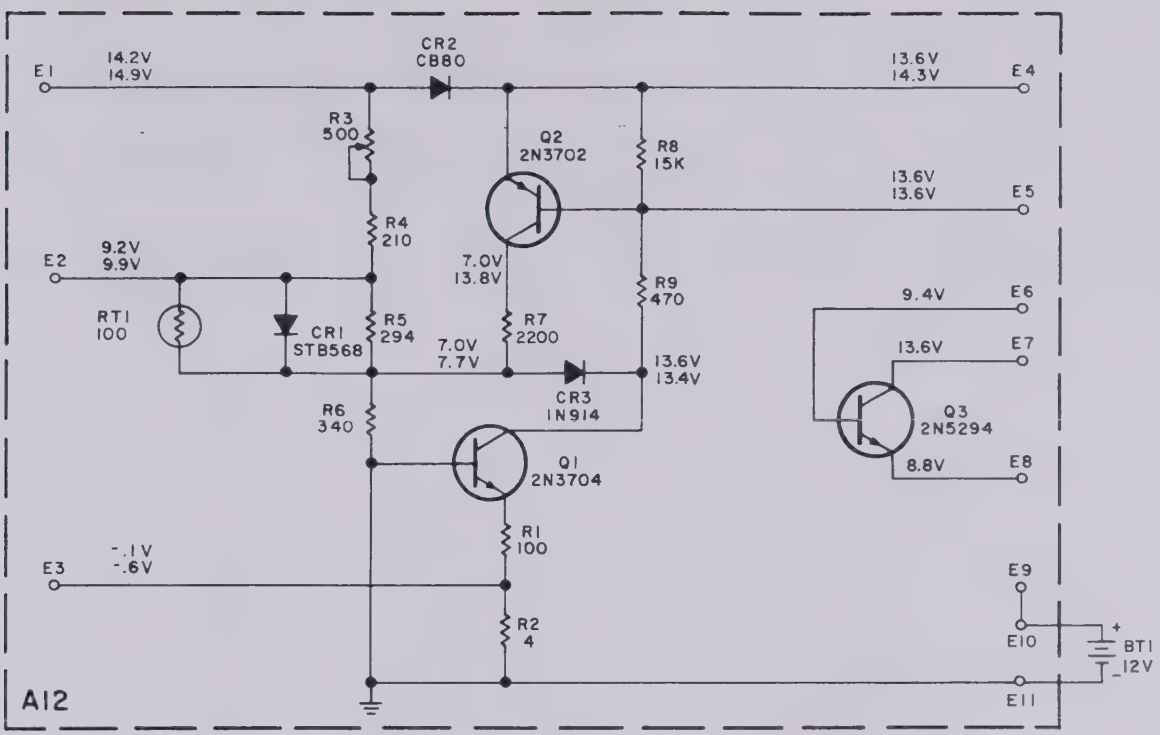


Figure 16. Schematic Diagram, Charging Control

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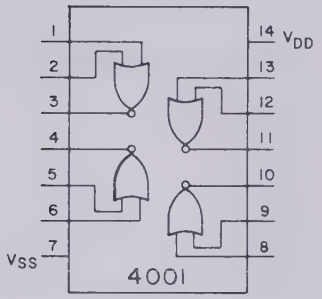
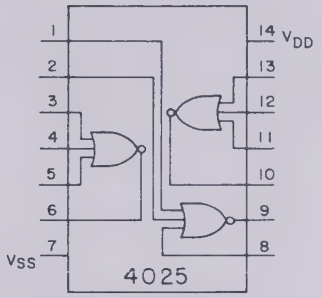
APPENDIX A

1. DIGITAL INTEGRATED CIRCUIT DESCRIPTION

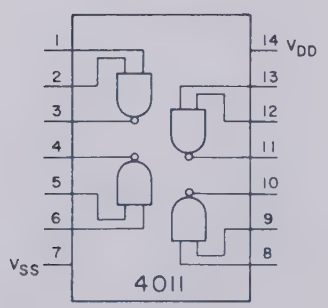
The following is a functional description of the digital I-C's used in the frequency display. These descriptions will aid the person servicing the the instrument in trouble shooting the display boards A9 and A10.

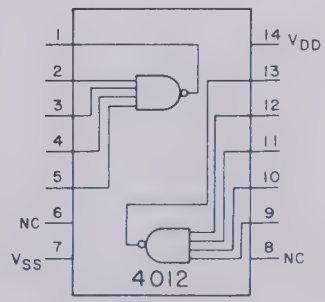
a. 4000 SERIES NOR-GATES. A positive logic Nor-Gate will only have a hi output when all inputs are lo. Any hi input forces a lo output.





b. 4000 SERIES NAND-GATES. A positive logic Nand-Gate will only have a lo output when all inputs are hi. Any lo input forces a hi output.





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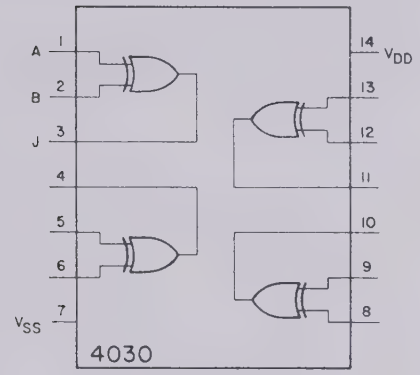
c. 4030 EXCLUSIVE-OR GATE. An Exclusive-Or Gate is a two input device. The output will be hi only when there is a single hi input. In order to have a single hi input, the inputs must be different. The output will be lo when both inputs are the same.



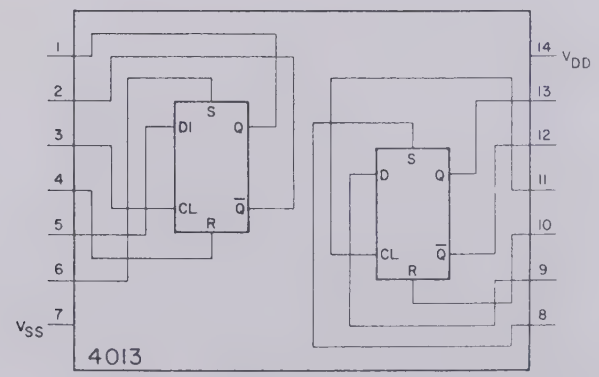
4030 TRUTH TABLE		
A	B	J
0	0	0
1	1	1
0	1	1
1	1	0

0 = LO
1 = HI

d. 4013 D FLIP-FLOP. A D Flip-Flop is an edge triggered Flip-Flop which is clocked by a rise of the signal at the clock input. Following a clock input and assuming lo state set and reset (clear) inputs, the Q output will be equal to the D input at the time of the clocking. A hi set input forces a hi Q output and a hi reset (clear) input forces a hi $\overline{Q}$ output.

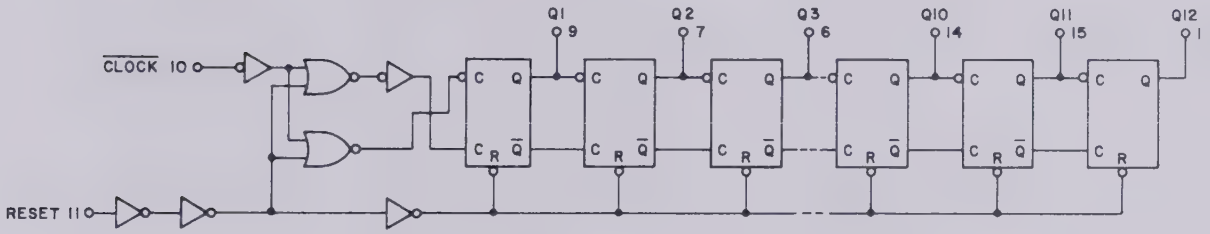
4013 TRUTH TABLE					
CL	D	R	S	Q	$\overline{Q}$
↑	0	0	0	0	1
↑	1	0	0	1	0
↓	X	0	0	NO CHANGE	
X	X	1	0	1	0
X	X	0	1	0	1
X	X	1	1	1	1

X = DON'T CARE
0 = LO
1 = HI



e. 4040 12 STAGE RIPPLE COUNTER. This counter consists of 12 ripple-carry binary counter stages. The counter is reset to its "all zeros" state by a hi on the reset input. The counter is advanced one count on the negative-going transition of each input pulse. A binary up count takes place when each stage changes state, each time the preceeding stage goes from a hi to lo output state.

LOGIC DIAGRAM



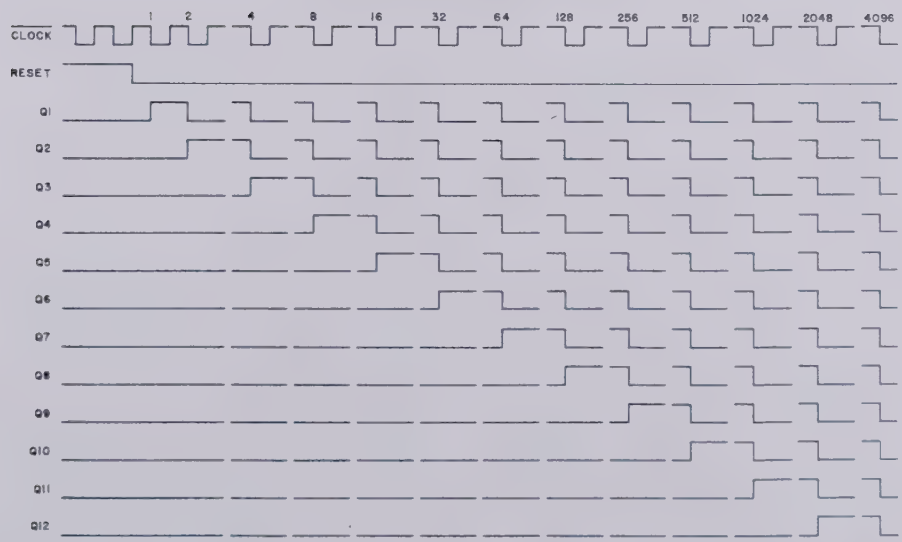
Q4 = PIN 5 Q7 = PIN 4 V_{DD} = PIN 16
Q5 = PIN 3 Q8 = PIN 13 V_{SS} = PIN 8
Q6 = PIN 2 Q9 = PIN 12

TRUTH TABLE

$\overline{\text{CLOCK}}$	RESET	OUTPUT STATE
⌐	0	NO CHANGE
¬	0	ADVANCE TO NEXT STATE
X	1	ALL OUTPUTS ARE LOW

X = DON'T CARE
0 = LO
1 = HI

4040 BINARY COUNTER
BINARY COUNTER TIMING DIAGRAM



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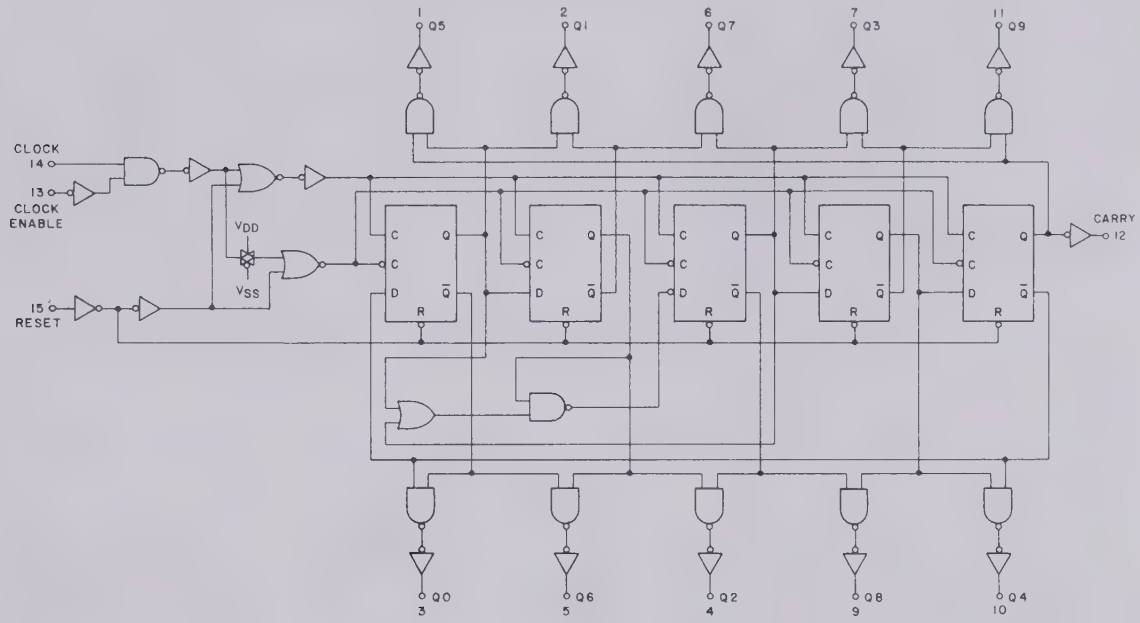
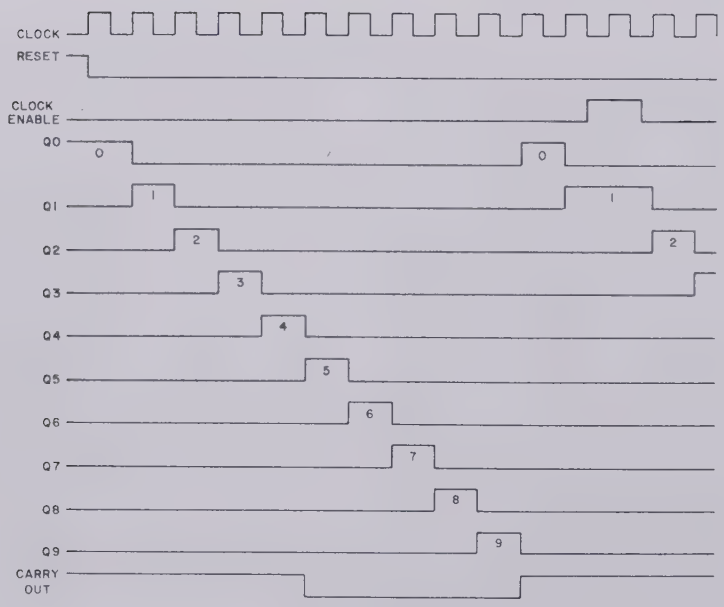
f. 4017 DECADE COUNTER. This decade counter has ten decoded outputs, one of which is hi for each count. The unit also has a carry output which is hi for counts 0-4. A hi Reset input places the counter in a 0 count state. The unit counts when the Count Enable input is lo and a rise of the count input occurs or when the Count input is hi and a fall of the Count Enable occurs.

DECADE COUNTER



TIMING DIAGRAM

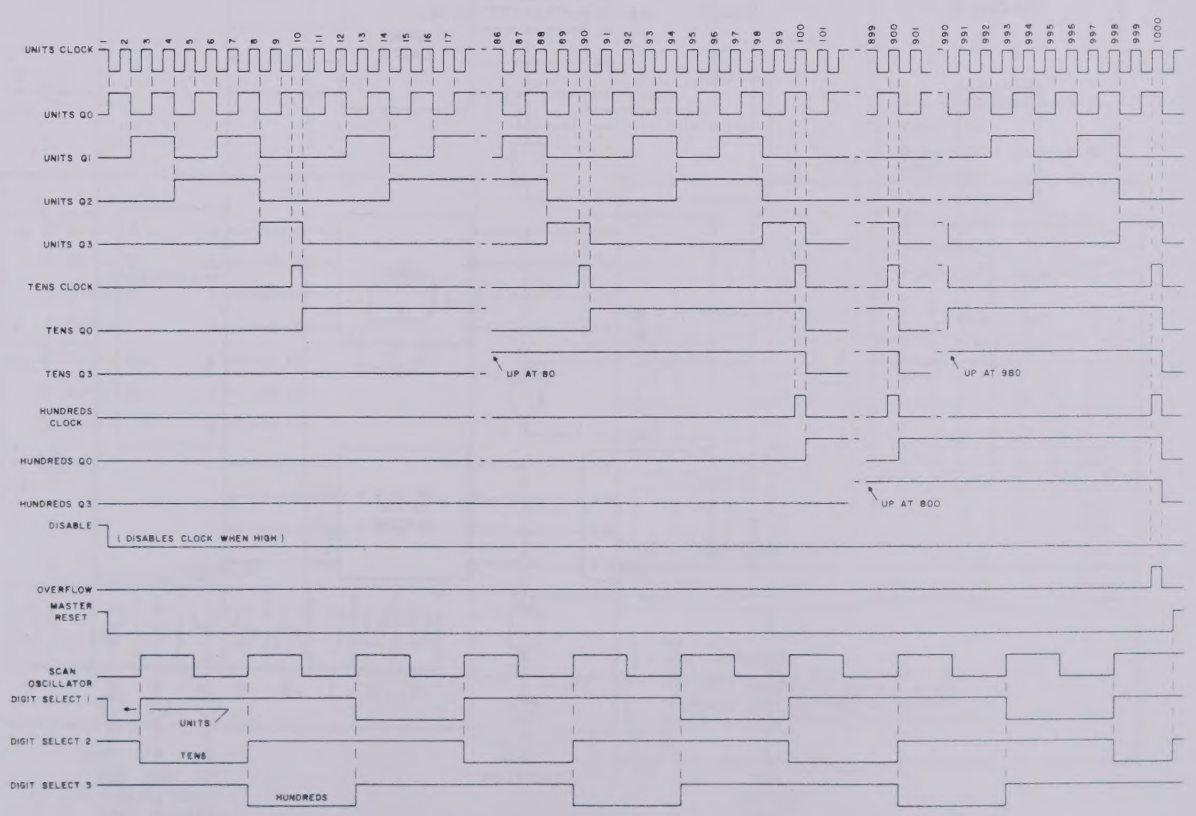


g. 4553 THREE DIGIT COUNTER. The three-digit counter consists of three negative edge-triggered BCD counters which are cascaded in a synchronous fashion. A quad latch at the output of each of the three BCD counters permits storage of any given count. The three sets of BCD outputs (active hi), after going through the latches, are time division multiplexed, providing one BCD number or digit at a time. Digit select outputs (active lo) are provided for display control.

An on-chip oscillator provides the low frequency scanning clock which drives the multiplexer output selector. The frequency of the oscillator can be controlled externally by a capacitor between pins 3 and 4 or it can be overridden and driven with an external clock at pin 4. Multiple devices can be cascaded using the overflow output, which provides one pulse for every 1000 counts.

A hi Master Reset initializes the three BCD counters and the multiplexer scanning circuit. While Master Reset is hi, the digit scanner is set to digit one; all three digit select outputs are disabled and the scan oscillator is inhibited. The Disable input, when hi, prevents the input clock from reaching the counters, while still retaining the last count. Information present in the counters when the latch input goes hi, will be stored in the latches and will be retained while the latch is hi, independent of other inputs. Information can be recovered from the latches after the counters have been reset if Latch Enable remains hi during the entire reset cycle.

TIMING DIAGRAM



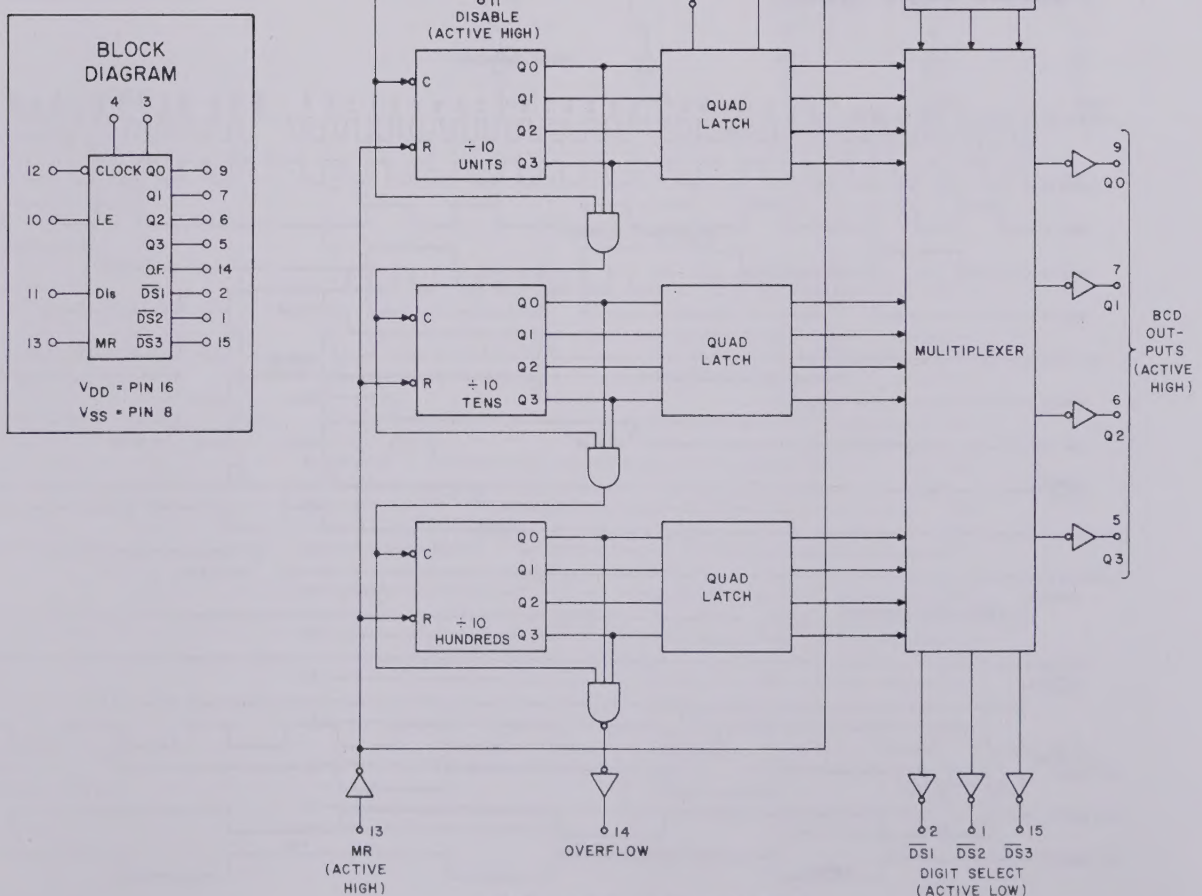
g. 4553 THREE DIGIT COUNTER. (cont)

TRUTH TABLE

INPUTS				OUTPUTS
MASTER RESET	CLOCK	DISABLE	LE	
0	⌐	0	0	NO CHANGE
0	¬	0	0	ADVANCE
0	X	1	X	NO CHANGE
0	1	⌐	0	ADVANCE
0	1	¬	0	NO CHANGE
0	0	X	X	NO CHANGE
0	X	X	⌐	LATCHED
0	X	X	1	LATCHED
1	X	X	X	Q0=Q1=Q2=Q3=0

X = DON'T CARE
0 = LO
1 = HI

EXPANDED BLOCK DIAGRAM

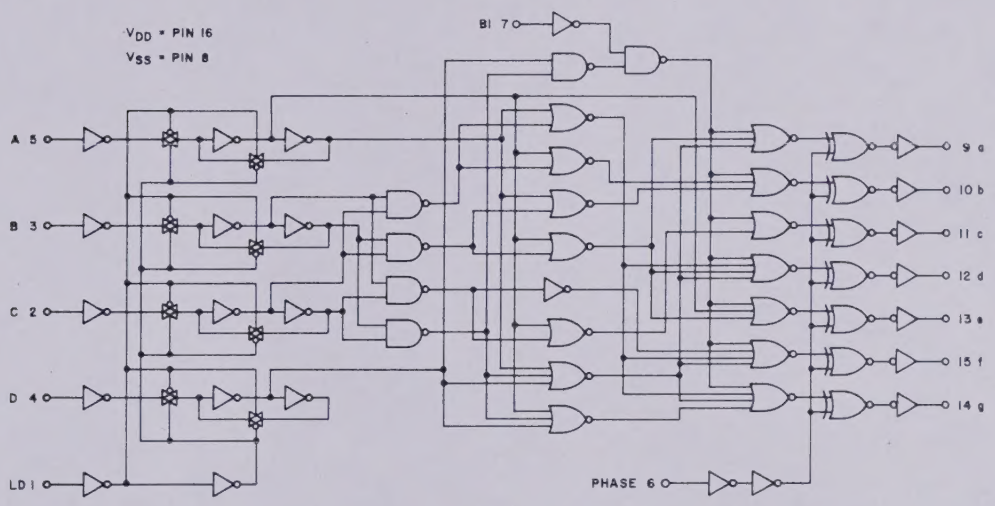


BLOCK DIAGRAM

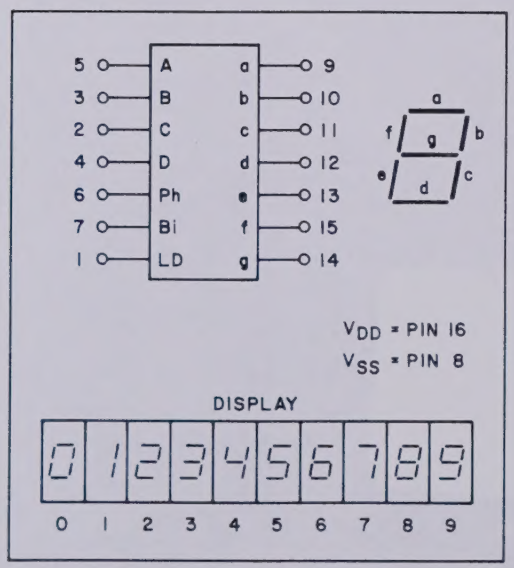
4553 THREE DIGIT COUNTER

h. 4543 BDC-TO SEVEN SEGMENT LATCH/DECODER/DRIVER. The BCD-to-seven segment latch/decoder/driver provides the functions of a 4-bit storage latch and an 8421 BCD-to-seven segment decoder and driver. The device has the capability to invert the logic levels of the output combinations. The phase (Ph), blanking (Bl), and latch disable (LD) inputs are used to reverse the truth table phase, blank the display, and store a BCD code, respectively.

LOGIC DIAGRAM



4543 BCD TO SEVEN SEGMENT
LATCH/DECODER/DRIVER



TRUTH TABLE

INPUTS							OUTPUTS							
LD	Bl	Ph*	D	C	B	A	a	b	c	d	e	f	g	Display
X	1	0	X	X	X	X	0	0	0	0	0	0	0	Blank
1	0	0	0	0	0	0	1	1	1	1	1	1	0	0
1	0	0	0	0	0	1	0	1	1	0	0	0	0	1
1	0	0	0	0	1	0	1	1	0	1	1	0	1	2
1	0	0	0	0	1	1	1	1	1	1	0	0	1	3
1	0	0	0	1	0	0	0	1	1	0	0	1	1	4
1	0	0	0	1	0	1	1	0	1	1	0	1	1	5
1	0	0	0	1	1	0	1	0	1	1	1	1	1	6
1	0	0	0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	0	0	1	1	1	1	1	0	1	1	9
1	0	0	1	0	1	0	0	0	0	0	0	0	0	Blank
1	0	0	1	0	1	1	0	0	0	0	0	0	0	Blank
1	0	0	1	1	0	0	0	0	0	0	0	0	0	Blank
1	0	0	1	1	0	1	0	0	0	0	0	0	0	Blank
1	0	0	1	1	1	0	0	0	0	0	0	0	0	Blank
1	0	0	1	1	1	1	0	0	0	0	0	0	0	Blank
0	0	0	X	X	X	X	**							**
†	†	1	†				Inverse of Output Combinations above							Display as above

X = Don't care
† = Above Combinations
* = For liquid crystal readouts, apply a square wave to Ph.
For common cathode LED readouts, select Ph = 0.
For common anode LED readouts, select Ph = 1.
** = Depends upon the BCD code previously applied when LD = 1.
0 = Lo
1 = Hi

MP MASTER
MA34766